Towards a Stability-Oriented Model for Organizational Demography Management: A Lifespan Approach

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From age to age, nothing changes, and yet everything is completely different.

Aldous Huxley

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Table of Contents

Figures & Tables

1 Introduction

The present thesis focuses on a stability-oriented lifespan model and its application to the work context. The starting point is a review of stability-oriented lifespan development and its regulation mechanisms in work context; this then leads to a stability-oriented model of lifespan development (chapter 1). Based on the current knowledge on stability-oriented lifespan development in the work context it outlines aims and research questions (chapter 2). Next the thesis provides an overview of the cognitive development in middle adulthood and of favorable and unfavorable contributing factors such as the work context (chapter 3). The question of how malleable these cognitive abilities prove to be through cognitive interventions arises in this context. A meta-analysis has been conducted in order to examine the effectiveness of memory trainings; effectiveness was analyzed among future members of the third age since there is little research on cognitive trainings in middle-adulthood and since there is a trend of extending work life due to the fact that human senescence has been delayed by a decade (chapter 4). The work context is one of the predominant contexts in midlife and a normal cognitive development is crucial for addressing the rising demands imposed within workplaces in constant evolution. Thus chapter five investigates to what extent a stability-oriented lifespan model is transferable to the work context. Relevant measurement instruments and regulation mechanisms for such stability-oriented models in the work context as well as suggestions for relevant means in human resources (HR) practices are outlined (chapter 6). Finally, a general discussion (chapter 7) relates the results to the presented aims and research questions and outlines theoretical, methodological and practical implications as well as consequences for future research.

1.1 Stability-oriented lifespan development in the work context

1.1.1 Lifespan development

Lifespan psychology studies individual development (ontogenesis) from conception to old age. A core assumption is that development is not completed at adulthood but that it is a lifelong process. Baltes, Staudinger, & Lindenberger (1999) formulated three main principles of lifespan development. The first principle derives from an evolutionary perspective and states that across the lifespan the expressions and mechanisms of the genome *lose in functional quality*, meaning that there are some cognitive abilities that decrease with age (e.g. information processing). The second principle postulates an age-related *increase in need for culture* and culture-based processes across lifespan. By culture the authors mean psychological, social, material, and knowledge-based resources such as cognitive skills, motivational dispositions, socialization strategies, social systems, physical structures and technology that are needed to generate and maintain high levels of functioning. The third principle states that there is an *age-related decrease in efficacy and efficiency of cultural factors and resources* during the second half of life – with large interindividual and interdomain differences existing in onset and rate of losses in efficiency. This suggests that development is not parallel, but differs between various resource and behavioral dimensions. These three principles interrelate and are relevant for three goals of ontogenetic development: growth, maintenance - including resilience -, and the regulation of loss (Baltes, 1990; Baltes et al., 1999). Moreover, lifespan development is marked by plasticity, meaning intraindividual potential or change in cognition under certain conditions. The older the adult, the more time and practice it takes to attain the same learning gains. In specific domains, older adults may not be able to reach the same levels of functioning as younger adults, even after extensive training and under positive life circumstances (Kliegl, Smith, & Baltes, 1989).

Furthermore, development is influenced by the dialectic interplay of historical and socio-cultural aspects that may generate cohort effects. Thus developmental patterns are relative to contextual variables and psychological development must be looked at from an interdisciplinary point of view. These presumptions on lifespan development are summarized in the table below (Table 1).

Table 1: *Summary of presumptions of lifespan development*

Concept	**Presumption**
Lifelong development	Development in different domains is not viewed as being complete at a specific age or life period (e.g. midlife). It rather extends over the entire lifespan.
Multidirectionality & multidimensionality	Development is marked by inter- and intraindividual multidirectionality and multidimensionality: growth, stability and loss in one person and different abilities (intraindividual variability) as well as different performances between different persons within the same ability (interindividual variability).
Growth, maintenance and losses of resources	Development is an interplay between growth, maintenance and losses of resources across lifespan.
Plasticity	Refers to a within-person variability.
Cohort effects	Development is marked by socio-cultural aspects.
Contextualism	Development is a dialectic interplay between age-related, socio-cultural and non-normative variables.
Interdisciplinarity	Psychological development needs to be looked at in an interdisciplinary context.

Indeed, the above concepts offer important presumptions on lifespan development. Yet questions about regulative mechanisms and the interplay of specific contexts such as the work context remain open. The concepts of contextualism (cf. chapter 1.1.2), multidirectionality/multidimensionality (cf. chapter 1.1.1), and plasticity (cf. chapter 3.3) bear special relevance for this thesis and will therefore be picked up again and addressed in the next chapters.

1.1.2 Contextualism

As seen above, development is codetermined by multiple systems of influence, namely (a) age-graded, (b) history-graded and (c) non-normative variables (Baltes, 1990; Baltes & Lang, 1997). The latter include biological and environmental determinants that are not applicable to many individuals and whose course is not predictable (i.e. critical life incidents). *Age-graded* variables are biological and environmental aspects that have strong links with

chronological age. Looking at cognitive development, the focus in research is on old age and there is comparatively little literature on cognitive development in middle adulthood (ages 40-65) so far but interest in this group is rising (Wahl & Kruse, 2005). While on the basis of stable means across middle age one could assume stability of abilities, the focus of midlife research is on interindividual differences in competence development, long-term effects of stressful versus supporting learning environments and the use of potentials for learning and training. Given that decline or dysfunction in old age is rather a product of life habits and behaviors than of chronological age, longitudinal data from middle adulthood to old age becomes very interesting in terms of prevention. An overview of the development of key cognitive competences and factors influencing negatively and positively developmental trajectories across middle age will be given in chapter 3. *History-graded* factors are bound to historical or socio-cultural determinants such as bio- and socio-demographical or technological influences. Looking at our socio-demographic development, age structures underwent a drastic change over the last decades. The percentage of Swiss citizens >65 years rose from 10.3% in 1960 to 16.6% in 2008, the percentage of people <20 years diminished from 31.8% to 21.2% over the same period. These figures are comparable to the European development (Swiss Federal Statistical Office, 2010). A scenario based on continuity regarding the past developments in fertility, mortality, and migration foresees an increase in the population aged >65 years and a decrease in the population aged <20 years over the next four decades. The percentage of the working population tends to decline; therein, middle-aged adults compose the biggest percentage of the workforce. This demographic change has a great impact on the workforces and is and will be a major challenge for enterprises. With the postponement of mortality and reaching old age in better health, the work life phase might expand (Vaupel, 2010). Besides this demographic change, our work environment is also more and more marked by changes and rising complexities such as the shift from rigid jobs with clearly defined sets of responsibilities to more flexible roles, competitive markets, performance orientation, and new technologies requiring faster and ubiquitous communication. All these trends cumulate in increasing environmental demands: individuals' stable cognitive performance, multi-tasking abilities, information processing or learning capabilities are stressed in order to contribute to organizational effectiveness (Hall & Mirvis, 1995; Maurer, Weiss, & Barbeite, 2003). Cognitive abilities are a core competence for continuous and stable job accomplishment and

performance, as well as continuous on- and off-the-job learning. Plasticity or adaptive capacity is therefore crucial in order to hold well-being, motivation or performance stable.

1.1.3 Stability orientation

As indicated in section 1.1.1, lifespan gerontology assumes a multidirectional and multidimensional development across lifespan. This means that in one person changes (growth and loss) and stability may coexist. Gain and loss do not evolve at the same pace; rather there is a shift with increasing age. Development is seen as a gain-loss dynamic and as change in adaptive capacity and involves a wide range of abilities and different resources. Lifespan development furthers the shift from a loss-based to a resource-based perspective of development that fosters the search for protective factors and resources in order to promote stability of certain life goals like autonomy, life satisfaction, subjective well-being or quality of life[1] (Baltes & Lang, 1997; Baltes et al., 1999).

Pursuing these goals, people use a variety of strategies in order to adapt their resources to changing demands. In terms of the concept of equifinality - the lifespan principle stating that individuals may reach the same final state, from different initial conditions and by a variety of paths – this means that individuals may reach an identical level of subjective well-being by many different means and combination of means. Similarly, it has been shown in the 'well-being paradox' that people report well-being even under unfavorable circumstances, for instance adverse health conditions or a bad financial situation (Staudinger, 2000). This leads to the assumption that an improvement in impaired functions or resources may not necessarily lead to higher quality of life and a decrease in resources not necessarily to a loss of quality of life. Contrary to expectations, there is a non-linear decrease in quality of life or subjective well-being with increasing age, compared to the increase of stresses and strains. On the one hand, due to their subjectivity, people may attribute different degrees of relevance to various factors considered as defining levels of quality of life. On the other hand individuals possess a certain adaptive potential (Martin &

[1] There is a lack of consistency between scientists in their approach to the concept of quality of life. Walker (2005) cites a classification of the concept of quality of life that distinguishes between macro-definitions (societal and objective variables such as income, employment, housing, and education) and micro-definitions (perceptions of overall quality of life, well-being, happiness, life satisfaction) of the concept. I will use the terminology used by the respective authors, but emphasizing that they all constitute elements of the broader term 'quality of life'.

Kliegel, 2010). This adaptive potential is very important in order to reach a form of equilibrium, above all in changing environments. Equilibrium models or models of homeostasis have been topics of biological, sociological and psychological research. For example, in matters of body temperature, a biological system attempts to keep the discrepancy or tension between the end state (in terms of goal state that the system aims to maintain) and the current state at a minimum (otherwise the body would react with breakdown or damage). In contrast psychological and social systems, instead of minimizing discrepancy, often aim at creating new states as they assume that in the long run this leads to a more powerful equilibrium system or a new steady state phase where the end state differs from the original one – this is called the adaptation level (AL). This level of "(…) preferred stimulation permits a sense of well-being and personal efficacy, and (…) with changing conditions, many systems are able to respond with re-setting of the values of AL" (Labouvie-Vief, 2009, p. 555).

Although these models differ in complexity and feedback-processes, they have in common that individuals and systems are in interaction with their environment and therefore exposed to internal (e.g. biological, age-related) and external changes (e.g. socio-demographic, technology, market). Along with these changes, individuals and systems need to re-organize (i.e. re-orchestration of resources) and to stabilize their (ideally already existing) equilibrium (Labouvie-Vief, 2009; Luhmann, 1984). This requires knowledge of the relevant variables or influencing contexts as seen in the previous section (resources, adaptive potential, demands) and knowledge of regulation mechanisms. The latter will therefore be outlined below.

1.2 Regulation mechanisms in lifespan development

1.2.1 Selection, optimization, and compensation

While the deficit theory of aging proposes the loss of developmentally relevant resources with aging, theories of successful aging are characterized by a focus on explaining the development of life satisfaction or subjective well-being. They are considered to result from successful adaptation of the individual to biological, social and psychological changes. The activity theory postulates a positive correlation between life satisfaction and a high social activity and interaction, whereas the disengagement theory suggests a negative correlation between social activity and participation in older age and life satisfaction. The continuity

theory forms a kind of middle position between these two theories and emanates from a preservation or continuity of internal and external structures (such as norms, attitudes, ideas, preferences, etc.) in the process of aging in middle and old age (for an overview see Martin & Kliegel, 2005; Baltes & Lang, 1997). These concepts contribute to the notion that different engagement levels exist, but do not consider that the engagement level may vary according to the situation.

The developmental model of selective optimization with compensation (SOC model) provides a more differentiated approach. It ties up to these theories and describes three strategies to successfully adapt to situations in which developmental losses predominate (Baltes et al., 1999). The authors have proposed a model based on lifespan psychology in which individuals may use *selection* to enhance goal domain identification on which to focus one's resources (elective selection), and goal restructuring as a result of experiencing a loss that threatens one's functioning (loss-based selection) – e.g. rehabilitation program after heart attack. *Optimization* may be used to acquire and orchestrate means, to intensify and train existing goal-directed means or to search for enhancing contexts. *Compensation* may be used to acquire new goal-directed internal and external means to respond to a) loss of means, b) changes in adaptive contexts and c) readjustment of goal structures. This leads to maximized objective and subjective gains and minimized losses (see Figure 1).

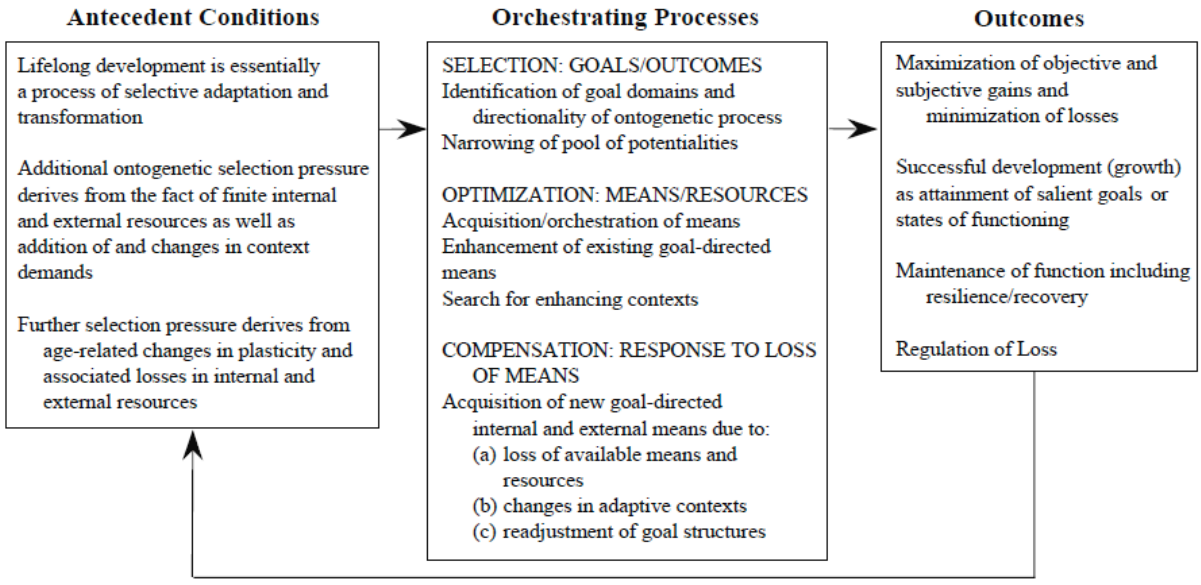

Figure 1: *The lifespan model of selective optimization with compensation (Baltes et al., 1999, p. 483)*

Research indicates that individuals experiencing resource allocation issues use SOC strategies at any age. Freund & Baltes (1998) found that SOC behaviors are used from early adulthood to late adulthood with middle-aged adults reporting the highest frequency of SOC behaviors. The SOC strategies have been linked to various general indicators of adaptive behavior such as positive psychological functioning, emotional wellbeing or life/aging satisfaction (Staudinger, 2000; Freund & Baltes, 1998; Riediger, Li, & Lindenberger, 2006). They have also been linked to domain-specific indicators of adaptive behavior such as job satisfaction or workplace performance. Thus Abraham & Hansson (1995) addressed successful aging in the workplace. They developed instruments to measure selection, optimization and one aspect of compensation (impression management = IM) in order to explore factors that may encourage older workers to try out such strategies at work, and in order to determine whether the use of these strategies can help account for the maintenance of older workers' job-related competencies. In a sample of 224 working adults (mean age=50) they found that the relationship between selection and self-reported ability/performance maintenance increased with age and that the relationship between both optimization and compensation-IM and goal attainment increased with age. Their results suggest that the SOC model may be useful in explaining how older workers can maintain important job competencies, and that characteristics of the job, of the workplace and of the individual may mediate the initiation and effectiveness of SOC behaviors.

Bajor & Baltes (2001) tested the hypothesis that the relationship between conscientiousness and job performance is mediated by resource allocation strategies specific to SOC. They surveyed 226 bank employees (75% female and 25% male; mean age=43.29, SD=9.86) working full or part-time, in a variety of jobs and working in their current position for an average of 6.90 years (SD=6.71). In general results lent some support to the role of SOC as a mediator. Specifically, results indicated that especially for managerial positions (positions with larger amounts of autonomy and responsibility), highly conscientious individuals are more likely to report using strategies of loss-based selection and compensation and that these strategies in turn lead to higher levels of performance. It can be speculated that these results are due to the fact that managerial positions are more complex and offer more diverse work tasks and therefore more room for self-directed behavior and in which SOC strategies prove potent.

All in all, the SOC model has been contributed a lot to the field of lifespan regulation by being applied to different age groups, by linking to different constructs like personality traits and by applying to specific contexts like the work context; its focus is though on individuals. A social-interactive approach - with focus on the social context - and a collective approach - with focus on social systems or organizations as a whole - could address interrelations between individual and organizational goals. These approaches will be brought into focus in chapter 5. Furthermore, the SOC model does offer strategies on how to minimize loss, maximize growth and maintain functioning. Nevertheless, application of the SOC strategies is more a reaction to change or loss than a preventive action. In other words, the focus is rather on the regulation of loss and not on the regulation or stabilization of equilibrium. Questions about when a resource is considered as loss or until when one should try to pursue one's goal through compensation or selection margins (influence of width of pool of available alternatives for selection and functionality for adaptive development) remain open.

In order to deepen the question of regulation mechanisms in development, other regulation mechanisms of lifespan development will be briefly described in the following sections. They all aim at allocating limited resources but have different focuses (social interactions, coping or control). The SOC model has already implicitly introduced some of these mechanisms.

1.2.2 Socio-emotional selectivity theory

According to the socio-emotional selectivity theory, social interactions are initiated and motivated by 1) personal emotional regulation, 2) development of self-concept, and 3) information search. The weighting of motivation is not constant but changes over lifespan, meaning that priorities change over lifespan. There is evidence for a reduction in social interactions in early adulthood and an increase in emotional closeness to people of importance - such as family members or close friends throughout adulthood (Carstensen, 1992). The author proposes a change in the purpose of social interaction over lifespan as a function of a shift in the individual's time orientation. This shift from 'time-since-birth' to 'time-till-death' perspective has consequences for models on work motivation across the lifespan that incorporate reorganization of goals as well as changes regarding importance and strength of motives (Kanfer & Ackermann, 2004); furthermore, the shift in an individual's time orientation has also implications on the 'psychological contract' between

employer and employee; the consequences it that such contracts constantly need to be renewed throughout the employment relation (Hall & Mirvis, 1995). Warr (2001) sees five sources of age-related changes in occupational motives: habituation to rewards and rising aspiration levels, development of habits over time, social comparison above all with younger counterparts, social pressure through age-stereotypes, and changes in self-efficacy regarding one's own performances. Zacher, Degner, Seevaldt, Frese & Lüdde (2009) shows age differences in content and characteristics of occupational goals. Younger employees in the service sector prioritize occupational goals in areas where they can expand their knowledge, training and payment issues, whereas older workers prioritize goals in the area of organizational citizenship and in areas where they can transfer their knowledge to others. The research shows that relationships in other occupational goal areas were non-significant but that employees stating goals in the area of well-being were older and those stating goals in new challenges, work time and job security were younger. Work centrality, the overall importance of work in a person's life, is positively related to development orientation, job development climate, affective commitment and intention to remain in the company (Armstrong-Stassen & Schlosser, 2008).

These regulation mechanisms have been linked to work context in various ways and demonstrate the importance of considering priority shifts over lifespan in the definition and implementation of means.

1.2.3 Person- and context-related regulation

The dual-process model of accommodation and assimilation as well as primary and secondary control mechanisms shows important self-regulation mechanisms with a focus on coping and control. These mechanisms are person-related; they also put context regulation to the fore. In the regulation concepts developed by Brandstädter, Rothermund, & Schmitz (1998; cited in Martin & Kliegel, 2005), accommodation and assimilation are protective resources for development regulation in order to deal with changes (loss) in resources. While *accommodation* refers to all processes adapting the self to the context, meaning adapting goals, priorities and demands to a hardly modifiable context or situation, *assimilative processes* aim to change situational or contextual factors to personal goals and priorities (i.e. compensatory means). Similar concepts to accommodation and assimilation are the ones elaborated by Heckhausen & Schulz (1995) who base their lifespan theory of development on primary and secondary control. While *primary control* refers to bringing the

environment into line with one's wishes, *secondary control* brings one's goals and attitudes in line with the environment. The authors propose systematic shifts across lifespan from primary to secondary control in the life course. Primary control mechanisms undergo an inversely u-shaped development over lifespan, whereas secondary mechanisms tend to rise with age. These two concepts outline the importance of regulating person-related and context-related variables in order to obtain a satisfying, stable state.

Similar to Baltes' framework of contextualism, Lerner (2002) proposed an interchange between development and context such as social relationships, culture, psychology, biology or historical changes. Behaviors are furthermore influenced by norms, attitudes, stereotypes or characteristics of the spatial environment. Optimal person-environment interaction constitutes an important regulation factor for well-being that indicates optimal person-context fit. Lawton & Nahemow's Ecological Model of Aging (1973) considers affective and behavioral outcomes as a result of interaction between personal abilities (competences) on the one hand, and the demands placed on the individual by his or her physical and social environment, or 'environmental press', on the other hand. A central feature of their framework is that favorable behavioral and affective outcomes are likely to result from a positive match between personal competences and environmental demands. Similar to this, but with a focus on health, Ilmarinen (2005) sees the regulation of work in the fit between the workers' resources (health, motivation, competences) and the work demands (leadership issues, work environment, work content, work organization). According to him, the workers' health status, competence, values (justice, respect, etc.), work content (content, work environment and work organization), the worker's family, social life and society all regulate work ability. Ilmarinen's model regulates work in a preventive way in order to implement adequate measures on time and to ensure organizational health.

Occupational context regulations usually are applied on the task-, structural- and organizational-level. Work and work conditions are considered to be important determinants of well-being: job satisfaction can be elevated with diverse, complex and work tasks that correspond to employee qualification (cf. Warr, 1993; Hackman & Oldham, 2010). Having its origin in work psychology, the Action Regulation Theory (Hacker, 1982) suggests that the completion of a work task requires certain psychological regulations. Work characteristics such as complexity, variability and completeness compose the regulation requirements. Social and work tasks inherent stressors may be regulation obstacles (i.e. bad

work organization, work climate, goal or social conflicts, time pressure). Resources like freedom of action, decision or social support from superiors and colleagues operate as regulation possibilities. These resources aim at stabilizing self-esteem, subjective stress perception and well-being. Warr, Butcher, Robertson, & Callinan (2004) showed that environmental characteristics at work such as opportunity for personal control (also described as decision latitude or self-determination), variety, environmental clarity (appropriate role behaviors) and physical security contributed significantly to the mediation effect of well-being.

So far the first two sections gave an overview on the lifespan development approach with emphasis on the presumptions most relevant for this thesis (plasticity, contextualism and multidirectionality and multidimensionality), and on regulation variables and mechanisms linked to the work context, which become important when applying a resource-based and preventive approach whose purpose is to maintain the stability of a given equilibrium state. The next section depicts a model that relates to the approaches of lifespan development and that integrates the regulation mechanism of resource orchestration, in order to make the linkage of the outlined factors more explicit and visible.

1.3 Stability-oriented lifespan model of resource orchestration

Regulation mechanisms and strategies are fundamental in order to adapt to situations or to change. By adopting a resource-oriented point of view, the focus is not on loss but on resources as they have a fundamental impact on successful aging. As seen in the previous chapter, subjective well-being, life satisfaction and quality of life have been described as indicators for successful aging (Baltes & Lang, 1997; Carstensen, 1992). As these are states usually aspired to, rather than reached, regulation aims at stabilizing these indicators of successful aging. As resources may be used for regulation of well-being or quality of life, successful aging might be more pronounced in individuals who are rich in resources because this might contribute to wider selection margins (Baltes & Lang, 1997; Riediger et al., 2006). On the other hand, (subjective) relevance of resource for goal attainment seems just as important (Staudinger, 2000).

Based on this and on the presumptions of lifespan development, the model of quality-of-life-management maps resource orchestration as developmental regulation mechanism (resource-orientation). The model takes into account coexistent variability and

stability within one person (multidimensionality and multidirectionality) and puts the aging person, their goals, competences and possibilities for resource use to the fore. It is based on the belief that a comparison of abilities between different ages only makes sense when considering their relevance for dealing with the different life tasks and challenges in different life phases (development as a lifelong process) and contexts (contextualism). The orchestration model considers individual presuppositions of the person and their context in order to achieve the personal relevant goals for maintaining or elevating quality of life. It assumes that the fundamental challenge in the aging process is to create an individual fit between person-based resources and context-based requirements and that this is also the basis for lifelong learning. According to the model, the aging person actively orchestrates his or her abilities and activities along with his or her goals of well-being and quality of life (person-orientation). The repertoires may vary but many combinations of a goal-oriented orchestration lead to the desired goal, following the principle of equifinality. This model takes into account resources and development-relevant regulative processes of a person in order to pursue individual goals (see **Figure 2** by Zöllig, Eschen, & Martin, 2010; Martin & Kliegel, 2005/2010).

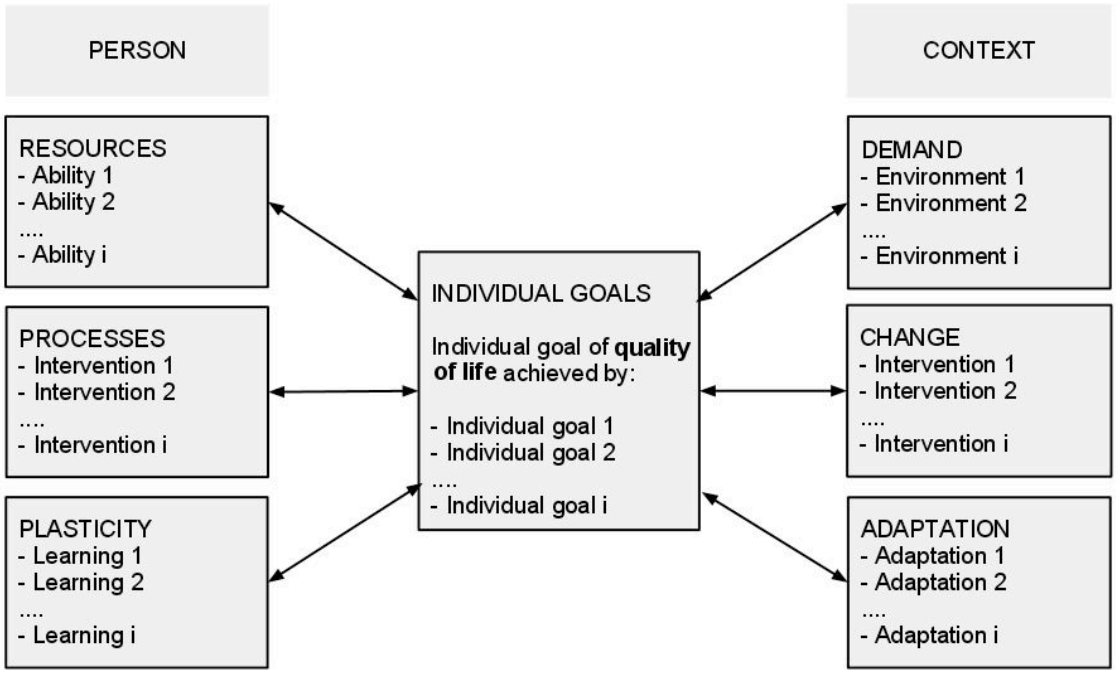

Figure 2: *Model of Quality-of-Life-Management through Resource-Orchestration*

The model focuses on maintenance or enhancement of individual goals like quality of life or well-being. This depends on individual resources (abilities), implemented processes (interventions) and adaptive potential (plasticity) on the one hand, as well as context-based requirements, context-based changes or adaptation to changes on the other hand. Prerequisites for successful adaptation to changes are knowledge about the fit between one's goals, own abilities, own context requirements, as well as personally effective and implementable interventions and adaptations. The resource-orchestration model is based on prevention rather than on a reaction to a discrepancy or impairment, and explains why stability may be possible. Identifying person- and context-relevant factors all along and conducting actual-theoretical comparisons between these factors may maintain stability. A prerequisite is that individuals pursue subjectively relevant goals and apply their available resources in order to achieve them – according to their changing capacities and needs. It is important to note, that quality of life is not only a dependent variable but might itself contribute to the development of new resources and developmental regulation.

The orchestration model serves as a base for memory training concepts and therefore promotes individual training concepts that are adjusted to individual prerequisites, resources and demands, and pursues the goal of empowering the individuals to memory managers. Similar to the SOC model, it focuses on individuals but has not yet been applied to work context or larger social entities or systems. The questions arising here are: How is this model transferable to work context and to a larger entity, a social and collective system? And what implications would this have? What would the relevant person- (resources, plasticity) and context-related variables (demands, changes), regulation mechanisms and interventions in work context be? What implications would such a model have on HR practices and management, and how could these be measured? These questions will be addressed in chapters 5 and 6.

2 Aims and Research Questions

After this introduction on lifespan development with a focus on context, stability-orientation and regulation mechanisms and their application to work context, an array of questions needs to be addressed.

Whereas the interest of this thesis lies in the individual and the work context, normal and stable cognitive functioning in middle adulthood plays a key role for coping with the demands rising from constantly changing work environments. A lot of research has been conducted with older people beyond the working age. Therefore the questions of "What do we know about cognitive development in middle adulthood?" - a population composing the heart of organizational staff - and "What are the enhancing and incriminating factors for this development?" arise and will be discussed in chapter 3. Given the fact that environments and demands change, and that some skills might become obsolete and others evolve from new demands, lifelong learning becomes more and more important. In order to maintain stability in cognitive functioning, the question about the malleability of abilities comes to the fore. Along with the research on cognitive development, research on cognitive training and interventions mostly focuses rather on old age than on middle adulthood, and only a few studies address this question with middle-aged adults as target groups. Supposing that training and learning patterns in old age may be similar in a prior life phase like middle adulthood and since the work life cycle could be prolonged with the postponement of senescence, this thesis tackles the question of the effectiveness of cognitive interventions and trainings among older adults (chapter 4).

Starting with the point of view that cognitive development in middle adulthood has to be seen in relation to individual goals, and that cognitive performance may be related to individual goals, the question is what variables, processes, or abilities lead to goal attainment in work context. According to equifinality, there are several ways to answer this question. As seen in the introduction, the stability-oriented model of resource orchestration and models of successful aging aim at stabilizing certain balances in order to attain individual goals like life satisfaction or well-being. A transfer of this model to work context along with an integrating approach of lifespan, work and organizational psychology, and HR practices is missing, though, and will be addressed in chapter 5. The transfer of such models to work context may lead to valuable insights on the identification and orchestration of relevant

stability- as well as person- and context-relevant factors and their possible relationship in the context of aging workforces, organizational well-being and organizational demography management. Therefore, the applicability of the stability-oriented model of resource orchestration and successful organizational aging and demography management, its measurement as well as its regulation through human resource management, need to be discussed in order to offer a plausible framework (chapter 6).

3 Kognitive Entwicklung im mittleren Lebensalter[2]

3.1 Leistungsfähigkeit im mittleren Alter

Die kognitiven Leistungen in der Altersgruppe der 40- bis 65jährigen sind in der Lebensspannenforschung bisher wenig differenziert untersucht worden (Wahl und Kruse, 2005), gewinnen jedoch in den letzten Jahren zunehmend an Aufmerksamkeit. Dies dürfte zum einen daran liegen, dass in Europa und den USA zunehmend größere Zahlen von Menschen von der kognitiven Alterung betroffen sind, zum anderen am Vorliegen von Langzeitdaten, die die Auswirkungen von Lebensstilfaktoren aus dem mittleren Alter bis ins hohe Alter nachverfolgen können. Darüber hinaus stellen kognitive Leistungen im mittleren Alter eine Schlüsselkompetenz zur Bewältigung von Arbeitsanforderungen, Bildung und Weiterbildung und gesellschaftlicher Partizipation dar (s. Baltes & Lang, 1997). Studien zur kognitiven Entwicklung sind dabei durch zwei Hauptansätze geprägt. Auf der einen Seite ist der Verlust kognitiver Leistungsfähigkeit Gegenstand der Forschung, also die Frage ab welchem Alter Personen mit einem erhöhten Risiko für einen späteren extremen Leistungsabbau identifiziert und allenfalls durch entsprechende Interventionen präventiv behandelt werden können (s. Schaie, 2000; Willis & Schaie, 2005). Zum anderen gibt es Hinweise, dass die intensive Nutzung von kognitiven Fähigkeiten im mittleren Alter möglicherweise kompensatorische Reserven bis ins hohe Alter bilden.

Im mittleren Alter wird die weitere Entwicklung kognitiver Fähigkeiten stärker als in anderen Altersgruppen durch die individuellen Umweltanforderungen beeinflusst (Sternberg, Grigorenko, & Oh, 2001). Unterschiedliche Arbeitsumgebungen beeinflussen demnach den Verlauf kognitiver Fertigkeiten (z.B. Kirlik & Bisantz, 1999; Willis & Schaie, 2005). Durch die intensiven, aber berufsspezifisch unterschiedlichen Trainingsanreize kognitiver Fähigkeiten müsste das mittlere Alter durch eine zunehmende interindividuelle Heterogenität gekennzeichnet sein. Tatsächlich zeigen sich in verschiedenen Untersuchungen berufsspezifische und individualisierte Veränderungsverläufe einzelner kognitiver Fähigkeiten (z.B. Moen & Wethington, 1999; Zimprich & Martin, 2009). So hat die

[2] This chapter is written in German because a similar version of it has already been published in „Wirtschaftspsychologie“ (Martin, Zehnder, & Zimprich, 2008)

Seattle Longitudinal Study (Schaie, 2005) den langfristigen Verlauf verschiedener intellektueller Fähigkeiten über das mittlere bis ins hohe Alter seit 1956 genauer untersucht (s. Willis & Schaie, 1999). Die Studie zeigt für schlussfolgerndes Denken, Wortschatz, verbales Gedächtnis und räumliche Orientierung Leistungshöhepunkte zwischen 40 und 60 Jahren, mit einer früheren Abnahme fluider Leistungen im Vergleich zu kristallinen, also erfahrungsabhängigen Leistungen. Informationsverarbeitungstempo und numerische Fähigkeiten beginnen vor dem mittleren Alter abzunehmen. Das mittlere Alter scheint also durch ein hohes Maß an Stabilität gekennzeichnet zu sein, so dass erklärbar ist, dass eine Reihe von Längsschnittstudien diese Altersgruppe vor allem als Referenzpopulation für die Feststellung von Alterseffekten nutzt und nur wenige die Veränderungen im mittleren Alter untersuchen (z.B. Bosma, van Boxtel, Ponds, Houx, & Jolles, 2003; Finkel, Pedersen, & Harris, 2000; Lamar, Resnick, & Zonderman, 2003). Diese Studien zeigen erhebliche Unterschiede in den Verläufen, mit erheblichen Anteilen von Personen mit steigender, stabiler und nachlassender kognitiver Leistung. Demnach ist das mittlere Alter nicht nur durch Stabilität, sondern auch durch unterschiedliche Arten von kognitiven Veränderungen innerhalb einzelner und über einzelne Fähigkeiten hinweg gekennzeichnet (cf. Dixon, De Frias, & Maitland, 2001).

Man unterscheidet hier zwischen struktureller Veränderung, absoluter Veränderung, differentieller Veränderung, Veränderung der Divergenz und allgemeiner versus spezifischer Veränderung (cf. Hertzog & Dixon, 1996). *Strukturelle Veränderung* bezieht sich auf die Stabilität von Kovariationsmustern zwischen Variablen über die Zeit oder in verschiedenen Altersgruppen. *Absolute Veränderung* bezieht sich auf die Quantität der Veränderung einer Fähigkeit über die Zeit oder in verschiedenen Altersgruppen. Obwohl man häufig an der Veränderung in einer einzelnen Person interessiert ist, wird absolute Veränderung meist durch die Untersuchung von Mittelwerten von Stichproben von Personen gemessen. In dieser Tradition werden entsprechend die Stichprobenmittelwerte zu verschiedenen Messzeitpunkten oder unterschiedlichen Altersgruppen miteinander verglichen (z.B. Schaie, 2005). *Differenzielle Veränderung* bezieht sich auf die Konsistenz von interindividuellen Unterschieden in kognitiven Fähigkeiten über die Zeit. Veränderung der Divergenz bezieht sich auf die Tatsache, dass bei Bezug auf Korrelationen unklar bleibt, ob die Varianzen sich über die Zeit verändern. *Allgemeine versus spezifische Veränderung* bezieht sich darauf, dass falls Veränderungen in kognitiven Fähigkeiten hoch korreliert sind, dies einen einzigen oder

wenige Faktoren als verantwortlich für die beobachteten individuellen Veränderungen nahe legen würde und dieser Faktor einen vergleichbar großen Anteil der kognitiven Veränderungen in jeder Einzelperson erklären kann. Intraindividuelle Variabilität bezieht sich darauf, dass bis vor wenigen Jahren die meisten Längsschnittstudien zum kognitiven Altern vor allem Mittelwertsveränderungen untersucht haben (s. Schaie & Hofer, 2001). Die heutige Befundlage zeigt jedoch klar, dass intraindividuelle Variabilität eine substanzielle Quelle systematischer Leistungsvariation zwischen Erwachsenen darstellt (Hultsch, Hertzog, Small, McDonald-Miszczak, und Dixon, 1992; Martin & Hofer, 2004).

Wie Martin & Zimprich (2005) zeigen konnten, besteht strukturelle Stabilität für wichtige Faktoren kognitiver Leistung vom frühen bis ins späte mittlere Alter, absolute Veränderung in Verarbeitungstempo und Gedächtnisleistung, aber auch größere differenzielle Veränderung für Gedächtnis als für Verarbeitungstempo und unterschiedliche Ursachen für die Veränderungen in verschiedenen kognitiven Leistungen. Diese Ergebnisse legen somit substanzielle Unterschiede in den Arten, Richtungen und Größenordnung von Veränderungen im frühen und im späten mittleren Alter nahe. So ist beispielsweise die Beziehung zwischen individuellen Unterschieden über einen Zeitraum von 4 Jahren zwischen Tempo und Gedächtnis im frühen mittleren Alter minimal (4% gemeinsame Varianz) und im Bereich von 25% gemeinsamer Varianz im späten mittleren Alter. Darüber hinaus beeinflussen Umweltfaktoren die Gedächtnisleistung im mittleren Alter stärker als die Tempoleistungen. Ob dies die Ursache für eine differenzielle Entwicklung kognitiver Leistungen im mittleren Alter sein kann, wird erst mithilfe von Längsschnittdaten beantwortbar sein, die die kognitiven Arbeitsanforderungen individuumsbezogen erfassen (s. z.B. Frieling, Bernard, Bigalk, & Müller, 2006; Schooler & Mulatu, 2001).

3.2 Einzelne kognitive Kompetenzen

Betrachtet man die Entwicklung von Intelligenz im Alter zwischen 50 und 65 Jahren genauer, zeigen aktuelle Daten im Mittel der längsschnittlich untersuchten Personen eine Leistungsveränderung. Dies gilt für intellektuelle Leistungen wie dem induktiven Schlussfolgern, den verbalen Fähigkeiten, der räumlichen Orientierung, der Zahlenfertigkeit, der Wortflüssigkeit und des Tempos der Informationsverarbeitung (Martin & Zimprich, 2005; Schaie, 2005). Dabei fällt das hohe Maß an *Variabilität* in verschiedenen Aspekten auf: (1)

Die Mittelwertsverläufe der fünf Primärfähigkeiten im Alter zwischen 46 und 74 Jahren unterscheiden sich zum Teil erheblich. (2) Einzelne Personen in der Stichprobe unterscheiden sich in den Verläufen einzelner Fähigkeiten. (3) Es gibt immer einen Anteil von Personen mit stabiler, zunehmender und mit abnehmender Leistungsfähigkeit. Während die Leistungen im Alter von 46 Jahren noch vergleichbar sind, können beispielsweise für den verzögerten Abruf deutliche Unterschiede von über 1.5 Standardabweichungen zwischen der schlechtesten und der besten Gruppe in der Leistung im Alter von 60 Jahren festgestellt werden (Willis & Schaie, 2005). Oftmals verstellt also der Blick auf die Durchschnittswerte den Blick auf die individuellen Möglichkeiten einer Leistungssteigerung oder eines Leistungserhaltes. Darüber hinaus muss betont werden, dass das Niveau, das in den meisten Fähigkeiten erreicht wird, etwa vergleichbar mit dem der 25-35-jährigen ist, die Leistungsverringerungen also von einem sehr hohen Leistungsniveau aus erfolgen. Stärkere und auch die Alltagsleistung beeinträchtigende Verringerungen finden sich erst deutlich später im sehr hohen Alter. Die Resultate der Seattle Longitudinal Study zeigen zudem Kohorteneffekte (Geburtskohorten von 1889 bis 1973) in den einzelnen kognitiven Fähigkeiten. Auf dem Konstruktlevel der Primärfunktionen werden lineare und positive Kohortenunterschiede im induktiven Schließen und Speed sichtbar (Schaie, 2005), wobei die jüngeren Kohorten besser abschneiden. Ein ähnlicher, aber nicht so steiler Verlauf ist bei der räumlichen Orientierung und dem verbalen Gedächtnis zu beobachten. Eine leicht negative Kurve findet man bei den numerischen Fähigkeiten und dem verbalen Verständnis, wobei um das Jahr 1945 und später Geborene einen Abfall der Leistungen in diesen beiden Fähigkeiten zeigen.

3.2.1 Gedächtnis

Bei der Verschlechterung der Gedächtnisleistungen von älteren Erwachsenen (Craik, 1999) handelt es sich um differenzierte und aufgabenabhängige Einbußen (für einen Überblick s. Martin, 2005). Zu den relativ stabilen Gedächtnisprozessen, in denen typischerweise keine Altersveränderungen auftreten, zählen die implizite Gedächtnisleistung, das Wiedererkennen von (auswendig gelernten) Informationseinheiten und das prozedurale Gedächtnis, da diese auch eine stark automatisierte Komponente beinhalten. Beim *Semantischen Gedächtnis* gibt es beispielsweise in Bezug auf das allgemeine Faktenwissen keine Altersunterschiede oder sie fallen sogar zugunsten der alten Personen aus. Allerdings gehören Schwierigkeiten, sich an Namen von Personen zu erinnern, zu den von Personen ab

dem mittleren Alter am häufigsten genannten Gedächtnisproblemen. Dies hat möglicherweise damit zu tun, das es beim Faktenwissen um allgemeines Wissen geht, das auf unterschiedliche Weise ausgedrückt werden kann. Handelt es sich dagegen um ganz eingegrenztes Wissen ohne Umschreibungsmöglichkeit wie bei den Namen, dann finden sich deutliche Altersunterschiede.

Beim *episodischen Gedächtnis* (Erinnerung an kürzlich geschehene autobiografische Ereignisse) werden durchgängig Altersveränderungen mit einer alterskorrelierten Verringerung der Wiedergabeleistung berichtet. Die Altersunterschiede sind zudem umso größer, je mehr Verarbeitung beim Abruf von Informationen erforderlich ist. Eine Unterstützung der Erinnerungsleistung ist durch zusätzliche Hinweisreize möglich, wobei alte und junge Personen davon profitieren. Bei der Unterstützung beim Lernen und Abrufen profitieren die Alten sogar oft mehr als die Jungen. Dies lässt darauf schließen, dass alte Personen seltener von sich aus die Hinweise aus der Umgebung für das Einprägen und den Abruf nutzen. Das könnte auch erklären, warum die Wiedererkennensleistung, bei der ja die Wahl zwischen bereits gesehenen Stimuli und neuen Distraktoren getroffen werden muss, ebenfalls nur geringe Altersunterschiede aufweist. Auch das *Quellengedächtnis* oder die Erinnerung an Kontextdetails ist mit zunehmendem Alter erschwert. Das *Autobiografische Gedächtnis* wird häufig als intakt erlebt, weil Ereignisse aus der Kindheit in ihrer Klarheit besser erinnert vorkommen können als kürzlich eingetretene Ereignisse. Allerdings ist die Erinnerung an ein lang zurückliegendes Ereignis oft eine an ein sehr markantes, besonderes Ereignis, das bereits häufig erinnert wurde. Durch diese Selektion und Wiederholung ist es schwer mit der Erinnerung an kürzlich eingetretene Ereignisse vergleichbar. Alternativ lassen sich Personen nach autobiografischen Erinnerungen und deren Datierung befragen. Hier zeigt sich bei jungen und alten Personen, dass Ereignisse umso schlechter erinnert werden, je länger die Ereignisse zurückliegen. Dabei ist auffällig, dass am häufigsten Ereignisse aus dem Lebensalter zwischen 10 und 30 Jahren berichtet werden. Entweder gibt es in dieser Zeit viele herausragende Ereignisse oder viele Ereignisse sind mit emotionalen Inhalten verknüpft und dadurch besonders gut enkodiert. Nimmt man Ereignisse der Zeitgeschichte ohne direkten persönlichen Bezug, ist das Bild sehr ähnlich, denn auch hier werden die Ereignisse von jungen und alten Personen umso schlechter erinnert, je länger sie zurückliegen.

Die *prospektive* Gedächtnisleistung, also die Fähigkeit, sich selbstständig an Absichten

zu erinnern, ist eines der am häufigsten berichteten Gedächtnisprobleme im Alltag Erwachsener (Kliegel & Martin, 2003). Dabei schneiden ältere Personen in alltäglichen und Alltagsaufgaben oft besser als junge Erwachsene ab, in unvertrauten Laboraufgaben zumeist schlechter (siehe **Tabelle 2**).

Tabelle 2: *Gedächtnisprozesse und deren Veränderlichkeit*

Relativ stabile Gedächtnisprozesse	Tendenziell eher veränderliche Gedächtnisprozesse
- Wiedererkennen	- Namensgedächtnis (semantisches
- prozedurales Gedächtnis	Gedächtnis)
- Allgemeines Faktenwissen (semantisches	- episodisches Gedächtnis
Gedächtnis)	- Quellengedächtnis
- autobiographisches Gedächtnis	- prospektive Gedächtnisleistungen

3.2.2 Handlungssteuerung

Betrachtet man nebst den Gedächtnisfunktionen die Handlungssteuerungs-Kompetenzen wie bspw. das *Planen von Handlungen*, so gibt es zwischen 50 und 65 Jahren kaum Hinweise auf bedeutsame Leistungsunterschiede in der Planungsleistung. Die beobachtbaren Veränderungen beziehen sich eher darauf, was geplant wird, zum Beispiel zunehmend häufiger die Erreichung außerberuflicher Ziele und wie effizient geplant wird. Aktuelle Studien belegen hierbei, dass die interindividuellen Unterschiede in der Planungsleistung größer sind als die durchschnittlichen Altersveränderungen (Kliegel, Storck, Martin, Ramuschkat, & Zimprich, 2003), und dass mit zunehmendem Alter die Planung vertrauter Inhalte, wie man sie in der Wegeplanung, Medikamenteneinnahmeplanung oder Einkaufsplanung untersuchen kann, ohne beobachtbaren Leistungsverlust durchgeführt wird. Dagegen treten bei der Planung völlig unvertrauter Aufgaben in virtuellen Umgebungen Altersunterschiede zutage (Kliegel, Martin, McDaniel, & Phillipps, 2007). Im Alltag treten alterskorrelierte Leistungsunterschiede in der Planungsleistung also praktisch kaum auf. Ebenso zeigen sich eine im Mittel große Stabilität im *induktiven Schließen* im mittleren Alter (39-60 Jahre) und ein signifikanter Abfall erst im Alter ab 67 Jahren (Willis & Schaie, 2005). Diese Ergebnisse decken sich mit den Ergebnissen einer Metaanalyse von Thornton & Dumke (2005), die keine signifikanten Unterschiede zwischen der Problemlösefähigkeiten von jungen (18-39 Jahre) und mittleren (40-59 Jahre) Erwachsenen fanden, während die älteren Erwachsenen (60+) im Vergleich zu den anderen beiden Altersgruppen schlechter abschnitten. Dagegen sind zunehmende Schwierigkeiten älterer

Erwachsener bei der *selektiven Aufmerksamkeit*, wie sie oft in Doppelaufgaben geprüft wird, sehr gut dokumentiert (z.B. Kramer, Larish & Strayer, 1995).

3.3 Plastizität

Dass Lernen von neuen Sachverhalten im Alter möglich ist und zu Leistungsverbesserungen beitragen kann, ist für eine Reihe von Fertigkeiten nachweisbar (s. Zimprich, Rast, & Martin, 2008). Beim verbalen Lernen wie beim Erwerb einer neuen Sprache oder dem Erwerb neuer Assoziationen beispielsweise zwischen Namen und Gesichtern zeigt sich ebenfalls, dass alte Personen Paarassoziationen erwerben, aber eine deutliche Alterssensitivität für den Lernaufwand und das Lerntempo bestehen. Hier zeigt sich auch, dass die Rahmenbedingungen des Lernens eine wichtige Rolle spielen. Die Erforschung der Frage, unter welchen Rahmenbedingungen die besten Lernleistungen im Alter erbracht werden können, hat eine Reihe von Altersveränderungen in der Bedeutung von Lernkontexten erbracht (für einen Überblick s. Martin & Kliegel, 2005). So profitieren in Trainingsstudien alte Personen stärker als junge Personen, wenn aus dem Alltag vertrautes Material verwendet wird, das Lerntempo selbst bestimmt werden kann, das Niveau an schulischer und beruflicher Bildung höher ist, die Lernenden körperlich gesünder sind, das Lernmaterial sensorische Veränderungen ausgleicht (z.B. durch Schriftgröße, Kontraste, Beleuchtung), Gelegenheit besteht, sich mit dem neuen Lernmaterial und der neuen Lernsituation zu beschäftigen, so dass man weiß, was auf einen zukommt, die Instruktionen konkret und eindeutig sind, externe Hilfen genutzt werden können, die Lernenden nicht ermüdet sind und sich nicht unter Zeitdruck wähnen, Störungen durch die Einführung neuen Materials minimal sind und das Lernen den individuellen Bedürfnissen und Stärken angepasst ist (s. Martin & Kliegel, 2005).

Es liegen nur wenige Befunde zur Wirkung kognitiver Trainings im mittleren Alter vor. Ausnahmen sind Studien zum informellen Lernen von Käser & Röhr-Sendlmeier (2002), die Studie von Lindenberger, Marsiske & Baltes (2000) zum Doppelaufgaben-Lernen oder die Studie zum individuellen Video-Imagery-Training bei mittleren und älteren Erwachsenen von West & Crook (1992). Des Weiteren lassen sich Studien zu den Auswirkungen eines körperlichen Trainings auf die kognitive Flexibilität von mittleren Erwachsenen (z.B. Netz, Tomer, Axelrad, Argov & Inbar, 2007) sowie berufsbezogener Fähigkeitsübung (Schwaninger, Hardmeier, Riegelnig, & Martin, 2007) finden.

Die bei den Autoren Kliegl, Smith & Baltes (1989) verankerte Untersuchungsweise des individuellen kognitiven Potentials oder der kognitiven Plastizität ist der Testing-the-Limits-Ansatz, bei dem durch einen maximalen Trainingsumfang die Grenze der möglichen Leistungsfähigkeit gemessen wird. Die Studie von Kliegl et al. (1989) konnte die Plastizität von Gedächtnisaspekten sowohl in der jüngeren und älteren Versuchspersonengruppe nachweisen – wobei die Verbesserung in den Abrufleistungen bei den älteren nicht so groß war wie bei der jüngeren Gruppe, was auf eine reduzierte Plastizität bei älteren Erwachsenen hinweist. Die Ergebnisse von Bherer, Kramer, Peterson, Colcombe, Erickson, & Becic (2006) zur Plastizität der Aufmerksamkeitskontrolle in Doppelaufgaben-Situationen sprechen für latente kognitive Reserven auch in Bezug auf Doppelaufgaben (gleichzeitiges Bearbeiten von auditorischer und visueller Aufgabe), da sich die Doppelaufgaben-Leistungen in den beiden untersuchten Altersgruppen mit dem Training (kontinuierliches, individuelles Feedback, Instruktionen) verbesserten. Das Verbesserungsmuster in Bezug auf die Reaktionszeit war bei beiden Altersgruppen gleich, bezüglich der Akkuratheit der korrekten Antworten verbesserten sich die älteren Probanden über den Trainingsverlauf jedoch stärker als die Jüngeren. Die altersbezogenen Unterschiede in den inter- und intrapersonellen Variabilitäten veränderten sich im Trainingsverlauf nicht und die intraindividuellen Unterschiede verringerten sich in beiden Altersgruppen in Funktion des Trainings. Es kann davon ausgegangen werden, dass diese Resultate in gleicher Weise für eine hier nicht untersuchte mittlere Altersgruppe gefunden werden. Denn auch Lindenberger et al. (2000) untersuchten eine Doppelaufgabe (Memorisieren von Wortlisten mittels Loci-Methode- und Lauf-Training während Durchlaufen eines vorgegebenen Parcours) bei verschiedenen Altergruppen (20-30, 40-50 und 60-70Jährige). Die Ergebnisse zeigten, dass sich die Abrufleistungen mit zunehmendem Alter stärker reduzierten, wenn das Material gehend und nicht stehend oder sitzend enkodiert wurde. Ebenso zeigten sie stärkere Einbußen in der Laufgeschwindigkeit und der Akkuratheit der Spazierwege bei gleichzeitiger Enkodierung. Diese alterskorrelierten Einbussen waren bereits bei den 40-50Jährigen sichtbar. Lauftraining verbesserte zwar die Laufgeschwindigkeit und die Laufakkuratheit in allen Gruppen, konnte aber die Altersunterschiede nicht reduzieren.

Nair, Czaja & Sharit (2007) untersuchten die Rolle von Alter, kognitiven Fähigkeiten (kristalline und fluide Intelligenzmaße), bereits gemachten Erfahrungen und vorhandenem Wissen im Zusammenhang mit Lernen am Beispiel einer computerbasierten simulierten

Kundenservice-Aufgabe bei 50-80-jährigen. Ältere Erwachsene und solche mit geringeren kognitiven Fähigkeiten zeigten höhere Leistungsverbesserungen. Diese Resultate deuten zwar auf alterskorrelierte Unterschiede im Erwerb von Fähigkeiten hin, die Plastizität kann sich jedoch je nach untersuchter kognitiver Fähigkeit und individuellem Ausgangsniveau der kognitiven Leistungsfähigkeit unterscheiden. Dabei scheint die mit dem Alter eher zunehmende kristalline Intelligenz für das anfängliche Aufgabenverständnis am bedeutsamsten, fluide Fähigkeiten dagegen eher für weitere Leistungsverbesserungen. Weiter konnten die Autoren zeigen, dass vorgängige Computer- und Interneterfahrungen nur einen kleinen Teil der interindividuellen Varianz in der Anfangsleistung und den Leistungsverbesserungen aufklärten, nachdem die Unterschiede in den kognitiven Leistungen kontrolliert wurden. Dies widerspiegelt Aussagen der Investitionstheorie, indem die kognitiven Fähigkeiten (hier kristalline und fluide Intelligenz) größere Varianzanteile aufklären als vorgängige Erfahrungen oder Wissen und somit Individuen mit einer höheren fluiden und kristallinen Intelligenz sich eher Wissen aus neuen Bereichen aneignen.

3.4 Einflussfaktoren auf kognitive Leistung

3.4.1 Belastende Einflüsse: Stress und depressiver Affekt

Mittels eines empirischen Beispiels kann gezeigt werden, dass auch über das mittlere Lebensalter hinweg nicht-kognitive belastende Einflüsse und depressiver Affekt eine Auswirkung auf die Entwicklung der kognitiven Leistung haben können. Anhand des Datenmaterials der Interdisziplinären Längsschnittstudie des Erwachsenenalters (ILSE) haben wir untersucht, ob und wie sich in einer Stichprobe von 511 Erwachsenen (Altersdurchschnitt 44.2 Jahre, SD 0.93, 47% männlich) belastende Lebensumstände im Sinne von relativ überdauerndem Stress auf depressiven Affekt und die kognitive Leistungsfähigkeit (fluide Intelligenz, Gedächtnis) auswirken können. Dabei wurden belastende Lebensumstände als Ausmaß der sozioökonomischen Belastung, der gesundheitlichen Belastung und der Belastung durch die Wohnsituation operationalisiert. Depressiver Affekt wurde über die deutsche Version der Self-Depression-Scale (SDS; Zung & Zung, 1986) gemessen. Fluide Intelligenz wurde über die HAWIE-R Subtests Bilder Ergänzen und Mosaiktest (Tewes, 1991) sowie über den Subtest Räumliches Denken aus dem L-P-S erhoben (Horn, 1983). Schließlich wurden Gedächtnisleistungen über den Bildertest (direkt und verzögert) und dem Impliziten

Gedächtnistest aus dem NAI (Oswald & Fleischmann, 1995) erfasst. In einem ersten Modell wurde geprüft, ob individuelle Unterschiede in der latenten Variable Stress interindividuelle Unterschiede in den Faktoren fluider Intelligenz und Gedächtnisleistungen vorhersagen. Die Ergebnisse zeigen, dass Stress in fluider Intelligenz etwa 9% und in Gedächtnisleistungen etwa 7% Varianz aufklärt, entsprechend kleinen bis mittelgroßen Effektstärken. Fluide Intelligenz und Gedächtnisleistungen korrelierten zu .36. Die Anpassungsgüte des Modells war ausgezeichnet (χ^2 = 38.6, *df* = 24, *p* > .01, RMSEA = .034). Die berichteten Zusammenhänge blieben nach statistischer Kontrolle von Unterschieden in der Schulbildung praktisch unverändert.

In einem weiteren Modell wurde überprüft, ob die gefundenen Effekte von Stress auf kognitive Leistungen durch depressive Stimmungen vermittelt werden. Dieses erweiterte Modell zeigte ebenfalls eine gute Anpassung an die Daten (χ^2 = 61.8, *df* = 50, *p* > .1, RMSEA = .021). Während Stress in depressivem Affekt 45% Varianz aufklärte, erklärte depressiver Affekt seinerseits 8% bzw. 6% Varianz in fluider Intelligenz und Gedächtnis. Die direkten Effekte von Stress auf Kognition waren nicht länger statistisch signifikant, was bedeutet, dass die Zusammenhänge zwischen Stress und Kognition vollständig über depressiven Affekt vermittelt werden. Insofern wirkt sich die leistungsmindernde Wirkung von Stress auf Kognition über depressiven Affekt aus, von dem bekannt ist, dass er zu einem Defizit in kognitiven Leistungen führen kann (Christensen, Griffiths, Mackinnon, & Jacomb, 1997).

Dieses Beispiel zeigt, dass äußere Umstände sich auf die Gefühlslage auswirken können, die ihrerseits wiederum zu Leistungseinbussen in kognitiven Aufgaben führen können. Wird das Denken von relativ kontinuierlichen, beharrlichen und willentlich nicht immer zu beeinflussenden negativen Gedanken dominiert, dann kann dies zu Gedächtnis- und Aufmerksamkeitsstörungen, verminderter Motivierbarkeit, eingeschränktem Planungs- und Problemlöseverhalten und psychomotorischer Verlangsamung führen. Diese Einschränkungen müssen nicht erst bei einer klinisch relevanten Depression auftreten, sondern spielen auch bei geringeren Graden depressiver Verstimmungen eine Rolle, wo sie sich insbesondere auch auf die weitere Entwicklung kognitiver Fähigkeiten auswirken können. Dabei gilt zu beachten, dass die dargestellten Ergebnisse querschnittlich sind, d.h., sie können nicht ohne weiteres entwicklungspsychologisch interpretiert werden. Eine längsschnittliche Überprüfung der aufgezeigten Zusammenhänge, in welcher überprüft wird, ob und wie die Veränderungen in Stress, depressivem Affekt, fluide Intelligenz und

Gedächtnisleistungen zusammenhängen, ist derzeit in Arbeit (s. auch Zimprich, Martin & Kliegel, 2003).

3.4.2 Fördernde Einflüsse

Die Forschung hat ihr Augenmerk vor allem auf zwei Variablen als potentielle Einflussfaktoren auf Altersunterschiede und kognitiven Leistungsveränderungen gelegt: Verarbeitungsprozesse, wie z.B. Informationsverarbeitungsgeschwindigkeit oder Kontextvariablen. Bereits Baltes, Nesselroade und Cornelius (1978) argumentierten, dass unterschiedliche Umfelder (z.B. „enriched“ vs. „deprived“ environments) sich hinsichtlich der Förderung von unterschiedlichen kognitiven Fähigkeiten unterscheiden. An dieser Stelle sollen vor allem drei Einflussfaktoren näher betrachtet werden, die eine fördernde Wirkung auf die Entwicklung kognitiver Fähigkeiten darstellen können: Lebensstil, Bildung und Arbeitsumgebung.

Lebensstil. Der “use it or lose it-Ansatz” geht davon aus, dass ein aktiver und engagierter Lebensstil in einem positiven Zusammenhang mit der Aufrechterhaltung von kognitiver Leistungsfähigkeit mit zunehmendem Alter steht. Hultsch, Hertzog, Small und Dixon (1999) untersuchten bei 250 mittleren und älteren Erwachsenen längsschnittlich den Einfluss der Ausführung von Alltagsaktivitäten (körperliche und soziale Aktivitäten, Selbsterhaltungsaktivitäten wie Kochen oder Einkaufen, Hobbies, passive (Radio, TV) sowie neue Informationsverarbeitung (z.B. Sprache lernen)) und subjektiver Gesundheit auf die kognitiven Leistungen (Abrufleistungen, verbale Flüssigkeit, Arbeitsgedächtnis). Sie fanden einen Zusammenhang zwischen intellektuellen Aktivitäten und Veränderungen der kognitiven Leistungsfähigkeit und spekulieren, dass die Ergebnisse nicht nur für eine Pufferfunktion von Aktivitäten gegen kognitive Leistungsverschlechterungen, sondern auch für die Hypothese sprechen, dass kognitiv leistungsfähige Personen aktive Lebensstile führen bis kognitive Einbussen ihren aktiven Lebensstil limitieren. Ähnliche Ergebnisse zeigen sich in einer Studie zum Einfluss von der Teilnahme an Freizeitaktivitäten und kognitiver Leistungsfähigkeit im mittleren Erwachsenenalter (35-55 Jahre): regelmäßige Ausübung von Freizeitaktivitäten hat einen positiven Zusammenhang mit kognitiver Leistung, unabhängig von Alter, Bildung und sozioökonomischen Variablen (Dellenbach, Zimprich & Martin, 2008). Kognitiv anspruchsvollere Aktivitäten wie bspw. kulturelle Aktivitäten, Lesen oder Vereinstätigkeiten weisen einen stärkeren Zusammenhang mit der kognitiven Leistungsfähigkeit auf als Aktivitäten mit geringerem kognitiven Anspruch (Singh-Manoux,

Richards & Marmot, 2003). Auch diese Ergebnisse müssen in gegenteiligem Wirkungszusammenhang gesehen werden, wie bspw. die Studie von Miller & Kohn (1983, in Schooler, 1984) zeigt. Dort wurde ein starker positiver Effekt von Arbeitskomplexität auf die Intellektualität von Freizeitaktivitäten gefunden.

Bei Wilson, Barnes, Krueger, Hoganson, Bienias & Bennett (2005) wurden 576 ältere Personen mit einem Durchschnittsalter von 80.2 Jahren (SD = 7.6) über ihre kognitiven Aktivitäten im Alter von 6, 12, 18 und 40 Jahren sowie im aktuellen Alter zum Zeitpunkt der Studie befragt. Mit wenigen Ausnahmen war eine höhere Frequenz an kognitiver Aktivität in jedem Alter mit einem höheren Level an kognitiver Funktionsfähigkeit im höheren Alter assoziiert. Die aktuelle kognitive Aktivität und die Ressourcen zu Hause (Anzahl Bücher, Tageszeitung, Bibliothekspass) im Alter von 40 Jahren korrelierten positiv mit dem kognitiven Level in den verschiedenen kognitiven Funktionen (episodisches und semantisches Gedächtnis, Arbeitsgedächtnis, Informationsverarbeitungsgeschwindigkeit, visuell-räumliche Fähigkeiten). Diese Ergebnisse zeigen einen verstärkten Zusammenhang von kognitiven Aktivitäten und dem mittleren und höheren Erwachsenenalter. In Bezug auf den Einfluss der Arbeitsumgebung konnten Abraham und Hansson (1995) anhand einer Untersuchung an 224 Arbeitskräften im mittleren Alter (40-69 Jahre) zeigen, dass der Zusammenhang zwischen einer Selektion von Arbeitsaufgaben und selbst berichteter Fähigkeit/Kompetenzerhaltung mit dem Alter (>49-Jährige vs. <49-Jährige) zunimmt.

Bildung. Bildungseffekte auf kognitive Veränderungen bleiben auch nach Kontrolle von Faktoren wie Geschlecht und Alter bestehen. Formale Bildung gilt als guter Prädiktor für Veränderungen der kristallinen Intelligenz, Gedächtnis und des mentalen Status und ist weniger prädiktiv für Veränderungen in der fluiden Intelligenz und der Informationsverarbeitungsgeschwindigkeit (Willis & Schaie, 2005). Berufsbezogen ist grundsätzlich zu erwarten, dass Personen mit höheren Qualifikationen häufiger in Tätigkeiten mit höheren Anforderungen, einer höheren strukturellen Komplexität, mehr Entscheidungsbefugnissen und Verantwortung zu finden sind (Willis & Schaie, 2005). So zeigen auch die Ergebnisse von Frieling et al. (2006), dass die Höhe der Qualifikation, definiert über die formale Ausbildung, mit den Lernförderlichkeitsdimensionen (Selbständigkeit, Partizipation, Variabilität, Komplexität, Kommunikation/Kooperation, Feedback und Information) und der selbst eingeschätzten Fach- und Methodenkompetenz signifikant positiv korreliert.

Mit der zunehmenden Bedeutung von lebenslangem Lernen rücken nebst formalen Bildungs- oder Lernformen auch weiterführende Qualifikationsmaßnahmen wie nicht-formales oder informelles Lernen in den Vordergrund (Dellenbach, Zimprich, & Martin, 2008). Die Teilnahme an Lernaktivitäten in der EU und der Schweiz ist sowohl alterskorreliert als auch bildungsabhängig, d.h. dass sich Personen ab 50 Jahren und Personen mit niedrigem Bildungsniveau weniger an Weiterbildungen beteiligen (Kuwan, Bilger, Gnahs & Seidel, 2006). Auch informelle Lernformen sind alters- und bildungsabhängig, jedoch weniger stark. Dies widerspiegelt auch eine Studie von Käser und Röhr-Sendlmeier (2002), die Alters- und Bildungseffekte im inzidentellen Lernen fanden. Dabei wurden den Probanden Fachtermini, Akronyme und Abkürzungen vorgelegt, die sie definieren sollten; in einem zweiten Durchgang wurden dieselben Begriffe unerwartet erneut vorgestellt und die Kenntnisse der Teilnehmer ermittelt. Jüngere Probanden (18 bis 34 und 35 bis 59 Jahre) zeigten dabei größere Verbesserungen im inzidentellen Lernen als die ältere Gruppe (60 Jahre und älter); Probanden mit hoher beruflicher Qualifikation lernten mehr als Teilnehmer mit eher niedriger Qualifikation und der Lernkoeffizient von Personen mit Weiterbildungserfahrung lag überzufällig höher als bei denen ohne Weiterbildungserfahrung, wobei sich diese Unterschiede nur bei Probanden des mittleren und höheren Alters finden ließen. Auch der Zusammenhang zwischen spezifischen Interessensgebieten wie Technik, Politik/Wirtschaft und inzidentellem Lernen scheint im mittleren Alter besonders ausgeprägt zu sein.

Arbeitsumfeld. Schooler (1984, 1999) geht davon aus, dass komplexe Umgebungen durch ihre Stimuli und Anforderungskriterien definiert sind. Je unterschiedlicher die Stimuli, desto größer die Anzahl der nötigen Entscheidungen und Handlungsalternativen und desto komplexer das Umfeld. Schooler argumentiert, dass aus einer kontinuierlichen Auseinandersetzung mit einem relativ einfachen Umfeld eine Verkümmerung der intellektuellen Fähigkeiten und eine Veränderung von Werten, Orientierungen und Verhaltensweisen, die mit dem reduzierten Level einhergehen, resultieren. Da angenommen werden kann, dass solche Veränderungen oder Anpassungen in jedem Alter auftreten können, sollten Veränderungen der Umgebungskomplexität die intellektuellen und Wertvorstellungen ebenfalls über die Lebensspanne hinweg, also während der Jugend sowie dem mittleren und höheren Erwachsenenalter, verändern. Während auch Hultsch et al. (1999) den Wirkungszusammenhang von einem aktiven Lebensstil und kognitiven Leistungen diskutierten, gibt es basierend auf Längsschnittdaten bei Schooler, Mulatu, & Oates (1999)

Hinweise auf einen reziproken Zusammenhang zwischen Arbeitskomplexität und kognitiver Leistung bei älteren Arbeitnehmern (<65 Jahre).

Seit 1974 erhebt Schaie (2005) im Rahmen der Seattle Längsschnittstudie mit dem Life Complexity Inventory (LCI) auch den Einfluss von Lebensstilfaktoren. Einer der drei Subfaktoren, der am meisten mit den kognitiven Primärfaktoren korreliert, sind die Arbeitscharakteristiken. Die Ergebnisse zeigen positive Auswirkungen von Arbeitskomplexität und Kontrolle für den Erhalt der kognitiven Leistungsfähigkeit. Ein geringes Ausmaß an Selbstbestimmung am Arbeitsplatz geht mit kognitiver Verschlechterung einher. Bei der Untersuchung von Frieling et al. (2006) stehen lernförderliche Arbeitsplatzgestaltungen für eine stimulierende Umgebung. Bei der Untersuchung des Zusammenhangs von selbsteingeschätzten Kompetenzen (Fach-, Methoden-, soziale Kompetenz, externale Kontrollüberzeugung und Selbstwirksamkeitserwartung) und der Lernförderlichkeit (Selbständigkeit, Partizipation, Variabilität, Komplexität, Kommunikation/Kooperation, Feedback und Information) am Arbeitsplatz an über 400 Mitarbeitern aus der Verpackungsmittelindustrie zeigten sich ebenfalls signifikant positive Korrelationen aller Dimensionen der Lernförderlichkeit mit der selbsteingeschätzten Fach- und Methodenkompetenz. Auch Becker & Milke (1998) diskutieren die Effekte des Alters auf die Leistungen bei amerikanischen Fluglotsen, einer Berufsgruppe, die relativ komplexen Arbeitsanforderungen (z.B. gleichzeitige Verarbeitung von visuellen und auditiven Reizen, Multitasking) ausgesetzt ist. Sie fanden signifikante Assoziationen zwischen einem computerbasierten Luftraumszenario-Test, der die Dimensionen „Delay“ (Verspätungen, Wartezeiten, Effizienz der Fluglotsen) und „Safety errors“ (Anzahl Zusammenstösse oder Berührungen, Abflug von inkorrekten Gates) abbildete, und dem Alter. Diese Korrelationen zeigten sich bereits bei einer Altersgruppe von 19-33-Jährigen, wobei die Wartezeiten und die Anzahl der Sicherheitsfehler mit zunehmendem Alter stiegen. Hier stellt sich für zukünftige Forschung die Frage, ob Erfahrung solche alterskorrelierten Veränderungen wettmachen könnte (s. Schwaninger et al., 2007).

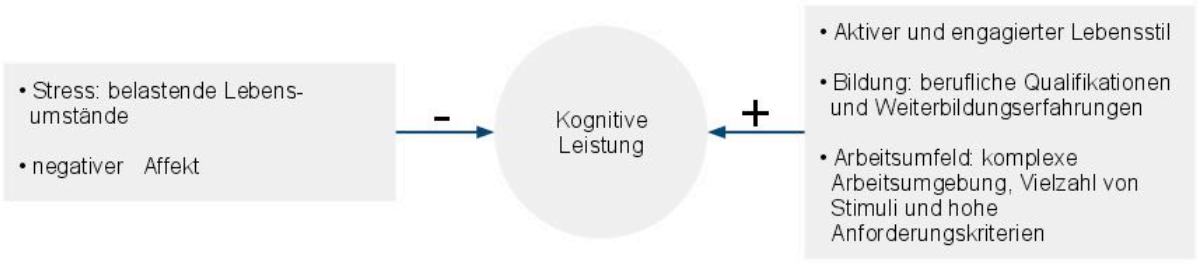

Figure 3: Mögliche Einflussfaktoren auf die kognitive Leistung

3.5 Diskussion

Insgesamt liegen relativ wenige Befunde im Hinblick auf differenzielle Entwicklungsverläufe kognitiver Fähigkeiten im mittleren Alter vor. Die vorliegenden Daten weisen darauf hin, dass in Abhängigkeit von Bildung, beruflichen und außerberuflichen Lernanforderungen und den spezifischen Lernaktivitäten von Personen mit sehr unterschiedlichen Fähigkeitsverläufen zu rechnen ist. Die Erforschung dieser Verläufe und der Möglichkeiten zur Unterstützung optimaler Entwicklungsverläufe bedarf jedoch auch einer konzeptionellen Grundlage. Die dargestellten Befunde stammen zum größten Teil aus einer Forschungstradition, die einzelne Fähigkeiten und deren Verläufe unabhängig von Kontexteinflüssen und individuellen kognitiven Aktivitäten untersucht. Wie hier gezeigt werden konnte, wirken sich schon allein die durch das berufliche Umfeld bestimmten Einflüsse sehr stark auf die Kompetenzentwicklung aus, so dass prädiktive Zusammenhänge von kognitiven Leistungen und der tatsächlichen Alltags- und Berufsleistung mittelalter Personen notwendigerweise gering ausfallen. Unseres Erachtens sind daher besonders im mittleren Erwachsenenalter, welches sich meist durch komplexe Rollen und Umfelder auszeichnet, zwei zukunftsweisende Forschungsrichtungen erforderlich. Dies ist zum einen die Erforschung der Entwicklung handlungsregulierender Fähigkeiten im mittleren Alter, insbesondere der Fähigkeiten zur Handlungsplanung, der Implementierung von Handlungsabsichten, des Lernens, der Adaptation, der Regulation von Emotionen und der Steuerung von Handlungsabläufen. Hier ist zu vermuten, dass in beruflichen Kontexten mit komplexen kognitiven Anforderungen weniger Maximalleistungen in basalen Fähigkeiten der Informationsverarbeitung prädiktiv sind als vielmehr die gelingende Koordination und Sequenzierung des Einsatzes kognitiver Fähigkeiten auf submaximalem Niveau, also die Fähigkeiten zur Handlungssteuerung.

Einen Schritt weiter geht die Sichtweise, zukünftig Kompetenzen stärker selbst als regulierte Fähigkeiten zu betrachten. In diesem Sinne ergibt sich die Berufsleistung nicht aus der gewichteten Summe von Einzelfähigkeiten, sondern man geht davon aus, dass die kognitiven Fähigkeiten von Individuen zur Erreichung selbstgewählter Ziele eingesetzt werden. Dies bedeutet zum Einen, dass die Entwicklung kognitiver Fähigkeiten im mittleren Alter nicht unabhängig von der individuellen Zielsetzung betrachtet werden kann. Diese Vorgehensweise erfordert zum Anderen die Betrachtung kognitiver Leistung unter einer Zielperspektive, da zuerst die Ziele einer Person darüber bestimmen, welche Fähigkeiten zur Zielerreichung geeignet sind. Die Frage ist dann, welche Prozesse zu einer erfolgreichen Zielerreichung führen und inwieweit die vorhandenen kognitiven Fähigkeiten (a) zum Einsatz kommen und sich (b) auf die Zielerreichung auswirken. Werden demnach kognitive Fähigkeiten zielabhängig eingesetzt, dann ist notwendigerweise kein starker Zusammenhang zwischen der Maximalleistung in einzelnen Fähigkeiten und der Berufsleistung zu erwarten, da flexibel jeweils mehrere Fähigkeiten zum Einsatz kommen. Konsequenterweise müsste also ein Zusammenhang zwischen der Maximalleistung in basalen Fähigkeiten und komplexen kognitiven Leistungen nur bestehen, wenn neue Anforderungen schnell bewältigt werden müssen. Für die individuellen Unterschiede in der längerfristigen und dauerhaften Erbringung von Leistung sind sie jedoch nur wenig prädiktiv. Eine zielbezogene und phasenspezifische Erfassung komplexer kognitiver Leistungen sowie des flexiblen Einsatzes und der Sequenzierung zieladäquater Fähigkeitenkombinationen wären also eine Konsequenz für die zukünftige Erforschung kognitiver Entwicklung im mittleren Alter.

4 Memory training effects as markers of plasticity: A meta-analysis[3]

4.1 Purpose

Understanding more about the processes underlying plasticity in cognitive performance may offer various avenues for supporting cognitive functioning in later life. Findings from a number of studies have indicated that cognitively-stimulating activities may help to protect against cognitive decline in later life (Wilson, Mendes de Leon, Barnes, Schneider, Bienias, & Evans et al., 2002). Building on these observations, researchers have attempted to enhance or maintain cognitive functioning in old people by means of systematic cognition-based interventions such as memory training (Willis, Schaie, & Martin, 2009). For theoretical as much as practical purposes, it is therefore important to establish to what extent cognitive performance can be improved through systematic training across adulthood and old age, and for how long gains can be maintained. Moreover, possible factors that influence the extent of any gain for a given individual, and the relative importance for magnitude of gains of different features of the training, such as intensity, frequency, duration, instructional procedures, or focus, need to be explored (Hoyer & Verhaeghen, 2006; Nyberg 2005; Willis 2001).

Research on memory training has focused on examining the potential for improvement of cognitive functioning in normal aging and on determining the limits of cognitive plasticity in old age (Hoyer & Verhaeghen, 2006; Kliegl, Smith, & Baltes, 1989; Verhaeghen, Marcoen, & Goossens, 1992). Cognitive plasticity refers to cognitive changes and adaptations, and especially to the potential performance of people under optimal conditions (Singer, Lindenberger, & Baltes, 2003). Generally, cognitive training research has focused on cognitive processes (e.g., processing speed, inhibition; Ball, Berch, Helmers, Jobe, Leveck, Marsiske, et al., 2002), primary mental abilities (e.g., inductive reasoning, spatial orientation, episodic memory; Schaie & Willis, 1986), higher order cognitive constructs (fluid intelligence, executive functioning; Jaeggi, Buschkuehl, Jonides, & Perrig, 2008), and global cognition involving multiple cognitive domains (Experience Corp; Fried, Carlson, Freedman,

[3] A similar version of this chapter has been published in „Restorative Neurology and Neuroscience“ (Zehnder, Martin, Altgassen, & Clare, 2009).

Frick, Glass, Hill, 2004). Most of these studies have targeted old adults with some kind of severe cognitive impairment. Several criteria have been involved in evaluating the effectiveness of cognitive training, and these criteria are of interest in the study of cognitive plasticity (Ball et al., 2002).

For the majority of old people the extent of any cognitive decline is relatively small, but some individuals develop more extensive difficulties and are at greater risk of developing a form of dementia. Current attempts focus on the identification of these individuals in the preclinical stage, which has led to the development of the diagnostic concept of Mild Cognitive Impairment (MCI). MCI applies to individuals with declining cognitive abilities, but largely preserved everyday functioning. Individuals with MCI display subtle cognitive changes that are not severe enough to fulfill diagnostic criteria for dementia, but are greater than those typically observed in their age group (Larrieu, Letenneur, Orgogozo, Fabrigoule, Amieva, & Le Carret, 2002; Petersen, Doody, Kurz, Mohs, Morris, & Rabins, 2001). Earlier definitions emphasized the differentiation from optimal aging (e.g. "Benign Senescent Forgetfulness"; Kral, 1962; "Age-Associated Memory Impairment"; AAMI; Crook, Bartus, Ferris, Whitehouse, Cohen, & Gershon, 1986), or the identification of preclinical dementia patients (e.g., "Malignant Senescent Forgetfulness"; Kral, 1962; "Cognitive Impairment, No Dementia"; CIND; Graham, Rockwood, Beattie, Eastwood, Gauthier, Tuokko, et al., 1997). The term MCI as defined by the American Psychiatric Association (APA, 1987) is a condition involving impaired short- and long-term memory, but no functional impairment. MCI is assumed to be a precursor of dementia, i.e., a transitional state between normal cognitive decline in old age and dementia. According to the diagnostic concept MCI as proposed by the International Working Group on Mild Cognitive Impairment (Winblad, Palmer, Kivibelto, Jelic, Fratiglioni, & Wahlund, 2004), the criteria for MCI are (a) the person is neither healthy nor demented, (b) there is evidence of cognitive deterioration which is either reflected in decline in neuropsychological test performance over time and/or subjective report of decline by self and/or informant in conjunction with objective cognitive deficits as defined by neuropsychological test performance below age-adjusted norms, and (c) activities of daily living are preserved and complex instrumental functions are either intact or minimally impaired. Due to the variability in definitions, studies investigating prevalence and incidence of MCI come to different conclusions (Kratz, 2002). Prevalence rates reported in the literature vary between 5% and 25% (Kumar, Dear, Christensen, Ilschner, Jorm, & Meslin,

2005; Manly, Bell-McGinty, Tang, Schupf, Stern, & Mayeux, 2005; Purser, Fillenbaum, Pieper, & Wallace, 2005), and incidence rates between 0.5 and 8% (Busse, Bischkopf, Riedel-Heller, & Angermeyer, 2003; Larrieu et al., 2002; Jungwirth, Weissgram, Zehetmayer, Tragl, & Fischer 2005).

Numerous studies report effects of cognition-focused interventions in old people. There is some evidence for cognitive plasticity in later life as well as a possible protective effect of engaging in cognitively-stimulating activity (Baltes & Lindenberger, 1988; Wilson et al., 2002; Hultsch et al., 1999). This suggests there may be potential to improve cognitive functioning in later life through cognitive training interventions, and this in turn might help to support continued independence and maximize quality of life for old people. For old people with MCI who are at increased risk of developing dementia cognition-focused interventions may help to improve or maintain their level of cognitive performance and thereby delay or prevent further decline (Hoyer, 2006; Wilson 2002). This is also targeted by memory training which is one of the most applied cognitive interventions (Hultsch et al., 1999; Schooler & Mulatu, 2001; Stern, 2002). However, so far it is unclear which factors may be responsible for any benefits resulting from memory training, and whether the same or different approaches are needed for healthy old people and old people with mild cognitive impairment (Nyberg, 2005).

Memory trainings may be offered in various forms, like individual or group sessions, and tasks may be presented in various modalities, including paper-pencil or computerized versions but all aim at performance improvement. Approaches differ with regard to trained abilities (e.g., memory, attention, speed of information processing) and specificity of training (e.g., training of text recall vs. multimodal and holistic approaches training a combination of abilities). In addition, strategies practiced in the training sessions (e.g., method of loci, imagery training), duration of training sessions, overall training period, frequency of training sessions, group size and participants' characteristics (e.g., education, personality, preferred learning style etc.) differ between studies. Standardized training tasks are used (Clare, 2003), but difficulty may be varied to adjust for individual's ability level. Effectiveness is considered in terms of improvements on test scores in the areas of cognitive functioning targeted in the training, maintenance of improvements over time, transfer of training effects to other kinds of cognitive tasks, and generalization of effects to everyday functioning.

Moreover, studies vary with regard to design and outcomes, and may use pre-post comparisons, randomized control groups or comparisons with active control conditions. Several meta-analyses have provided detailed descriptions on the effectiveness of specific memory training types. Verhaeghen et al. (1992) focused on memory training gains in episodic memory tasks and evaluated effect sizes as a function of the type of mnemonic trained, whereas Floyd and Scogin (1997) examined the effectiveness of memory training on subjective memory functioning and mental health of older adults. Sitzer, Twamley, & Jeste (2006) and Clare, Woods, Moniz-Cook, Orrell, & Spector (2003/2007) summarized cognitive training effects for old people with a diagnosis of dementia. In contrast to these previous meta-analyses the present review focuses on i) healthy old people and people with mild cognitive impairment; ii) memory trainings with outcome measures such as immediate and delayed recall or name-face associations; iii) randomized controlled trials (RCT) to prevent selection bias in allocating interventions to participants (participants are assigned to receive a specific treatment intervention by a chance mechanism so that the value of a treatment will be shown in an objective way and therefore the study groups are unbiased) and to gain information on treatments' effectiveness in comparison to no contact control groups and active control groups (receiving an alternative treatment).

The present article aims to 1) provide an overview of the effectiveness of memory trainings for healthy old people and people with mild cognitive impairment, 2) discuss limitations of existing knowledge regarding the effectiveness of trainings and 3) suggest concrete steps for future research on how to improve knowledge regarding effective memory trainings.

4.2 Method

A meta-analysis on 24 randomized controlled memory training studies reported in the literature from 1970 to 2007 was conducted.

4.2.1 Literature Search

The trials were identified from a search of the Specialized Register of the Cochrane Dementia and Cognitive Improvement Group (CDCIG) on 30 September 2007. This register contains records from the major healthcare databases *The Cochrane Library*, MEDLINE, EMBASE, PsycINFO, CINAHL and LILACS The CDCIG as well as many ongoing trial databases

from UK, Netherlands, USA/International. We used the search terms: 'cognitive stimulation' OR 'cognitive rehabilitation' OR 'cognitive training' OR 'cognitive retraining' OR ‘cognitive re-training’ OR 'cognitive support' OR 'memory function' OR 'memory rehabilitation' OR 'memory therapy' OR 'memory aid*' OR 'memory group*' OR 'memory training' OR 'memory retraining' OR 'memory support' OR 'memory stimulation' OR 'memory strategy' OR 'memory management'. These search terms were used in combination with Phases 1 to 3 of the highly sensitive search strategies for identifying reports of randomized controlled trials in MEDLINE (APPENDIX 5b, Cochrane Handbook, 2006), and all terms were searched as title, abstract, keyword, and publication type. These results were supplemented by searches from January 1970 to September 2007 in PsycINFO/PSYNDEX, ISI Web of knowledge and Pubmed. The search terms used in these searches were: 'memory training', 'mnemonic training', 'cognitive training', 'cognitive rehabilitation', 'cognitive intervention', 'cognitive exercise' in combination with 'elderly', 'old adults', old age', ‘MCI’, ‘mild cognitive impairment’, ‘memory complainers’, ’AACD’, 'dementia', 'dementia treatment', and 'dementia therapy'. Dementia terms were included because training studies targeting old people with a form of dementia may also include healthy old control groups or groups with people with mild cognitive impairment and could therefore be relevant for this review. After searches of the major databases were completed, reference lists from acquired studies and recent meta-analyses were examined to find additional randomized control trials.

4.2.2 Types of interventions

We focused on randomized control trials, for which adequate information (such as age group, mean values, and standard deviations) was provided. The studies included have been published in English or German in a peer-reviewed journal (in order to avoid reporting overlapping data in journals and book chapters). Studies were considered for the review if they described memory training interventions. Only studies with cognitive outcome measures, such as any measures of cognitive functioning, improvement, sustainability and transfer of training effects, were included. Duration of intervention was up to one year with at least a baseline and a post-intervention assessment reported. Studies were only included in the review if they recorded participants' performance at least at two time points.

To date, most studies investigating the effectiveness of cognitive interventions have used pre-post designs or relied on comparisons with alternative approaches, active control conditions, or waiting list control conditions. In this review, we coded the groups as being

either a) a no contact control group, when no treatment (apart from testing) was given; b) an active control group, when the control group was active in some way but the given treatment was not a memory training (i.e. relaxation training) or when training was some combined treatment (i.e. memory training and art discussion); c) treatment group, when a memory training was given.

In the literature, the handling of multiple training or control groups has been solved in many different ways. One could subject any study that has multiple treatment conditions to a randomization process whereby only one treatment is selected for inclusion in the meta-analysis or consider each cognitive training-control comparison as a separate study (i.e., Sitzer et al., 2006). When several control groups were compared to the treatment group, e.g., no contact control group and active control group, we decided to consider each treatment-control comparison as a separate study in order to maximize information extraction from the database.

4.2.3 Participants

To meet inclusion criteria for the review, participants (both male and female) had to be aged 60 years or older, and to be either healthy old people or old people who met criteria for mild cognitive impairment, but without a diagnosis of dementia. In order not to exclude studies that might be relevant for the review, none of the specific definitions of mild cognitive impairment were particularly included or excluded, but information on participants' cognitive ability was required for classification of individual cognitive status. Participants could be trained in any setting (group or individual).

4.2.4 Procedure and analysis

Searches were conducted as described above to identify all relevant published studies, and hard copies of all articles were obtained. Randomized controlled trials were identified and four reviewers worked independently to determine which studies met criteria for inclusion before reaching a final consensus. The quality assessment was conducted by using the approaches described in the Cochrane Reviewers' Handbook (Higgins & Green, 2008): In category A (adequate), the report describes allocation of treatment by some form of centralized randomized scheme, such as e.g. having to provide details of an enrolled participant to an office by telephone to receive the treatment group allocation; category B (intermediate) is where the report describes allocation of treatment by use of a ''list'' or

''table'' to allocate assignments, use of ''envelopes'' or ''sealed envelopes'', stating the study as ''randomized'' without further detail. Category C (inadequate) is where the report describes allocation of treatment by alternation, reference to case record numbers, dates of birth, day of week, or any such approach, any allocation procedure that is transparent before assignment, such as an open list of random numbers or assignments. Empirical research has shown that lack of adequate allocation concealment is associated with bias. Trials with unclear concealment measures have been shown liable to yield more pronounced estimates of treatment effects than trials that have adequate measure to conceal allocation schedules, but the effect is less pronounced than inadequately concealed trials (Chalmers, Celano, Sacks, & Smith, 1983; Schulz, Chalmers, Hayes, & Altman, 1995). Trials were therefore considered if they conformed to categories A or B, but those falling in category C were excluded.

Data from the RCTs selected for inclusion was extracted. Summary statistics (n, mean and standard deviation) were used for each rating scale at each assessment time for each treatment group in each trial to detect change from baseline. For cross-over trials only the data from the first treatment period was used. When change from baseline results was not reported, the required summary statistics were calculated from the baseline and assessment time treatment group means and standard deviations. In this case, as is customary in reviews adhering to the standards of the Cochrane Review Group, a zero correlation between the measurements at baseline and assessment time was assumed. Although this method may overestimate the standard deviation of the change from baseline, it is the most conservative approach, thus ensuring a high validity of the results from the meta-analysis.

Baseline assessment was defined as the latest available assessment prior to randomization, but no longer than two months before prior testing. For each outcome measure, data from those who completed the trial was sought and indicated as such. However, in order to allow an intention-to-treat analysis, wherever possible the data was sought irrespective of compliance, whether or not the person was subsequently deemed ineligible or otherwise excluded from treatment or follow-up.

Based on the goal of determining if particular memory constructs could be improved through interventions, we grouped the studies based on the trained outcome, thus assuming that interventions were similar to the degree they were targeting the same memory construct. Since none of the trainings was completely identical and differed at least with

respect to duration and sample, grouping by intervention technique would have mostly lead to the same grouping. The present study aimed at exploring whether memory trainings, in general, do have an effect on memory performance and not at finding out which technique is most effective. Consequently, outcome measures were derived from the evaluation instruments used and then grouped based on the following memory subgroups: immediate and delayed recall of words, paragraphs or stories, face-name recall, paired associate learning, visuo-spatial and short-term memory.

Data on outcome measures were pooled as homogeneous subgroups whenever possible within the memory domain. We pooled studies with sufficient data that were judged to be clinically homogeneous using RevMan software. We conducted forest plots with integrated statistical tests for heterogeneity (chi-squared test). When studies were statistically heterogeneous (I^2 test value > 50%), a random-effects model was used; otherwise a fixed-effects model was adopted.

4.3 Results

4.3.1 Search results and selected studies

Included in statistical analyses were studies that a) included healthy subjects or people with mild cognitive impairment b) included a pre- and post-treatment measure of memory performance (studies that investigated long-term effects through follow-up were not included), c) provided sufficient statistical data for the computation of effect sizes. A total of 24 memory training studies were retrieved to be included in the current meta-analysis and were pooled for calculations.

Regarding allocation concealment, two studies were ranked as grade A and 22 as grade B. Twenty-one of the included studies involved healthy old people and three of them investigated people with mild cognitive impairment. Main reasons for excluding studies were i) studies included patients with more severe cognitive impairments than MCI; ii) no RCT; iii) studies were reviews or not journal articles; iv) were written in neither English nor German; v) contained missing data; vi) age range; vii) no pre/post design.

Included memory training intervention studies for healthy old people focused primarily on the training of the memory domain using one or multiple mnemotechniques (i.e. memory skills training, self-monitoring approach for improving older adult learning,

imagery, method of loci, self-studied memory training manual, mnemonic training, memory strategy training) to improve the target construct. Studies varied considerably in terms of number of training sessions and overall duration of the intervention: number of training sessions in hours ranged from six to 135 hours, overall period of the cognition-based intervention from one day to one year. Less divergent but still variable and not always indicated, were pre- to post-test intervals and training to post-test intervals. Eighteen interventions were conducted in group settings with a trainer or tutor, only two study settings were self-instructional, two studies used single and group setting, the setting of 2 training remains unclear.

The total sample of old study participants consisted of 2229 persons, with an estimated mean age of 69.9 years (SD 3.53; mean age was estimated from midpoint of age range for those studies in which mean age was not reported). Overall, 24 studies, consisting of 767 healthy old adults and 34 participants with mild cognitive impairment, 442 no contact controls and 986 active controls were included in the analysis. The studies are presented in the Appendix including intervention groups, study sample sizes, mean ages, MMSE, duration of training and outcome variables were available (see also Martin, Clare, Altgassen, Cameron, & Zehnder, 2011).

4.3.2 Effects

Data of 24 randomized controlled trials were pooled. Results are summarized in tables 1-4. Tables contain information on the outcome measure, number of studies, number of participants, statistical method used (fixed or random effects model as well as confidence interval), effect estimates (and effect ranges in parenthesis), heterogeneity measures and overall effect sizes. The magnitude of effect size estimates is defined as small, d= .20; medium, d=.50 and large, d=.80 (Cohen, 1988). Positive effects sizes denote that the treatment (memory training) group showed better performance on the outcome measures than the corresponding control group, negative effects favor the control groups.

For healthy old adults, performances on paired associate learning ($p < 0.05$), immediate verbal recall ($p = 0.001$) and delayed verbal recall ($p = 0.006$) improved significantly following training compared to a no contact control condition (see Table 3).

Table 3: *Healthy Old Adults: Treatment versus no Contact*

Outcome measure	**Number of Studies**	**Partici-pants**	**Statistical Method**	**Effect Estimate**	**Heterogeneity**	**Test for overall effect**
face-name immediate recall	4	170	Mean Difference (IV, Fixed, 95% CI)	0.58 [-0.52, 1.67]	Chi2 = 4.96, df = 3 (P = 0.17); I2 = 40%	Z = 1.03 (P = 0.30)
face-name delayed recall	3	119	Mean Difference (IV, Fixed, 95% CI)	-0.24 [-1.62, 1.14]	Chi2 = 0.03, df = 2 (P = 0.98); I2 = 0%	Z = 0.34 (P = 0.73)
visuo-spatial memory	3	83	Mean Difference (IV, Random, 95% CI)	0.40 [-1.03, 1.84]	Tau2= 2.46; Chi2 = 7.56, df = 1 (P = 0.006); I2 = 87%	Z = 0.74 (P = 0.46)
short-term memory	6	457	Mean Difference (IV, Random, 95% CI)	2.21 [-0.79, 5.21]	Tau2 = 18.74; Chi2 = 460.38, df = 4 (P < 0.00001); I2 = 99%	Z = 1.50 (P = 0.13)
paired associates	3	120	Mean Difference (IV, Fixed, 95% CI)	2.71 [1.65, 3.78]	Chi2 = 0.58, df = 2 (P = 0.75); I2 = 0%	Z = 4.98 (P < 0.00001)
immediate recall	23	1074	Mean Difference (IV, Fixed, 95% CI)	0.16 [0.06, 0.26]	Chi2 = 45.86, df = 22 (P = 0.002); I2 = 52%	Z = 3.26 (P = 0.001)
delayed recall	13	1203	Mean Difference (IV, Fixed, 95% CI)	0.88 [0.26, 1.51]	Chi2= 22.97, df = 12 (P = 0.03); I2 = 48%	Z = 2.76 (P = 0.006)

Comparing the treatment group to the active control condition, there are some performance gains for the memory training groups but effects were only significant for the outcome variable face-name immediate recall (strong positive effect estimate = 0.93, p = 0.0004, see Table 4) and visuo-spatial memory. The first effect demonstrates that memory training has yielded non significant performance gains in immediate recall of face-name associations compared to a no contact control group but significant training gains compared to the active control group. This indicates that in this comparison any kind of memory training has an impact on memory performance.

Table 4: *Healthy Old Adults: Treatment versus Active Control*

Outcome measure	**Number of Studies**	**Partici-pants**	**Statistical Method**	**Effect Estimate**	**Tests for heterogeneity**	**Test for overall effect**
face-name immediate recall	10	581	Mean Difference (IV, Fixed, 95% CI)	0.93 [0.41, 1.44]	Chi2 = 14.59, df = 8 (P = 0.07); I2 = 45%	Z = 3.53 (P = 0.0004)
face-name delayed recall	3	364	Mean Difference (IV, Random, 95% CI)	0.47 [-0.59, 1.54]	Tau2 = 0.62; Chi2 = 7.17, df = 3 (P = 0.07); I2 = 58%	Z = 0.87 (P = 0.38)
visuo-spatial memory	3	149	Mean Difference (IV, Fixed, 95% CI)	-0.94 [-1.66, -0.22]	Chi2 = 10.85, df = 2 (P = 0.004); I2 = 82%	Z = 2.57 (P = 0.01)
short-term memory	6	442	Mean Difference (IV, Random, 95% CI)	2.23 [-0.68, 5.14]	Tau2 = 12.88; Chi2= 484.01, df = 5 (P < 0.00001); I2= 99%	Z = 1.50 (P = 0.13)
paired associates	4	424	Mean Difference (IV, Random, 95% CI)	-0.49 [-1.15, 0.16]	Tau2 = 0.32; Chi2 = 12.45, df = 6 (P = 0.05); I2 = 52%	Z = 1.47 (P = 0.14)
immediate recall	19	1468	Mean Difference (IV, Random, 95% CI)	0.54 [-0.10, 1.17]	Tau2 = 1.38; Chi2 = 71.47, df = 24 (P < 0.00001); I2= 66%	Z = 1.66 (P = 0.10)
delayed recall	10	503	Mean Difference (IV, Random, 95% CI)	0.17 [-1.07, 1.42]	Tau2 = 2.27; Chi2 = 29.65, df = 9 (P = 0.0005); I2 = 70%	Z = 0.27 (P = 0.79)

Another significant effect estimate resulted for the outcome measure visuo-spatial memory but it was negative (effect estimate = -0.94, p = 0.01), indicating that the active control group training was more effective than the memory training. This could be due to the uneven sample sizes and the strong weight of the study with the negative training effect (see Table 5).

Table 5: Healthy Old Adults: Treatment versus Active Control; Outcome: Visuo-Spatial Memory

	treatment group			active control group				
Study ID	**mean**	**SD**	**total**	**mean**	**SD**	**total**	**weight**	**Effect estimate**
Caprio 1996	-0.21	2.4	61	1.65	2.58	56	62.8%	-1.86 [-2.77, -0.95]
Fabre 2002	2.5	1.33	8	2.2	2.47	8	13.6%	0.30 [-1.64, 2.24]
Fabre 2002	2.5	1.33	8	1.7	1.67	8	23.5%	0.80 [-0.68, 2.28]
TOTAL			**77**			**72**	**100%**	**-0.94 [-1.66, -0.22]**

For individuals with mild cognitive impairment, data were scarce, but analyses indicated significant training gains. However, only in immediate recall effects were significantly better for the treatment condition (memory training) than for the no contact control condition (p=0.04). For delayed recall, the memory training was not significantly effective compared to a no contact control group. The improvement for immediate recall however, was unspecific as it did not exceed the improvement from the active control condition (drug treatment/drug treatment plus memory training) (see Table 6 and Table 7). The effect estimate of the treatment group compared to the active control condition is negative which means that for people with mild cognitive impairment the active control group showed more training gains in immediate recall than people with mild cognitive impairment with the memory training. In this comparison, this indicates that the drug treatment was more effective than the memory training.

Table 6: *MCI: Treatment versus no Contact*

Outcome measure	**Number of Studies**	**Partici-pants**	**Statistical Method**	**Effect Estimate**	**Tests for heterogeneity**	**Test for overall effect**
Immediate recall	5	110	Mean Difference (IV, Fixed, 95% CI)	1.73 [0.10, 3.37]	Chi2 = 1.27, df = 2 (P = 0.53); I2 = 0%	Z = 2.07 (P = 0.04)
Delayed recall	4	73	Mean Difference (IV, Random, 95% CI)	2.89 [-1.44, 7.22]	Tau2 = 3.30; Chi2 = 1.17, df = 1 (P = 0.28); I2 = 14%	Z = 1.31 (P = 0.19)

Table 7: *MCI: Treatment versus Active Control*

Outcome measure	Number of Studies	Partici-pants	Statistical Method	Effect Estimate	Tests for heterogeneity	Test for overall effect
Immediate recall	2	73	Mean Difference (IV, Random, 95% CI)	-2.36 [-11.52, 6.79]	Tau2 = 45.67; Chi2 = 7.02, df = 2 (P = 0.03); I2 = 72%	Z = 0.51 (P = 0.61)

4.4 Conclusions

The aims of this study were to give (a) an overview on the effectiveness of memory training interventions in healthy old adults and old adults with mild cognitive impairment as a marker of plasticity, (b) to discuss limitations of existing knowledge regarding the efficacy of those interventions and (c) make concrete suggestions for future research on cognitive interventions in order to improve knowledge on their efficacy.

Regarding the first aim, considering the large time span covered, surprisingly few studies were identified that fulfilled the rather flexible inclusion criteria (randomized control trials for which adequate information was provided, studies have been published in English or German in a peer-reviewed journal, describing memory training interventions, studies with cognitive outcome measures and a pre- and posttreatment measure of memory performance, participants are older than 60 years and either healthy or mildly cognitively impaired).

Results show that most interventions were effective in terms of performance improvement, with improvements following training for the treatment group. However, for healthy old adults, the effects were significantly better for treatment compared to no contact control in only three of seven memory domains, namely paired associate learning and immediate and delayed recall. There were no significant differences between treatment and active control groups but in face-name immediate recall, demonstrating that training effects were mostly not specific. This might indicate that simple contact or simple unspecific stimulation in alternative treatments (such as in the active control conditions) may be as effective as memory trainings. The same pattern of results with regard to effects in comparison to active control conditions was revealed in individuals with mild cognitive impairment.

With respect to the second aim, limitations of existing knowledge regarding the efficacy of memory training interventions may have several reasons. Several studies did not fulfil inclusion criteria. Most critical reasons for exclusion were (a) non-availability of information on details of participants' recruitment, exact procedure, and treatment of temporary non-compliance, and (b) lack of a control condition. Furthermore, adequate allocation concealment (double-blind) was only guaranteed for one of the included studies. Future studies should aim to fulfill relevant criteria to be treated as category A-studies. Furthermore, it appears that studies vary enormously with respect to potentially influential factors such as overall length of intervention, number of treatments, group sizes, exact testing procedure, assurance of equal training procedures, combination of training contents within and across sessions, training and similarity of trainers, or pre-existing training experience. In addition, it was not always obvious how the evaluation instruments were matched to the content of training (which would be expected to improve the reported effects). Thus, when conducting the meta-analyses, we decided to use the complete available information at the cost of homogeneity of the included studies. Also, with regards to the variability of duration and intensity of the trainings, we did not divide data in to smaller time periods and did not conduct separate meta-analyses. Thus, future analyses of larger numbers of studies may provide better evidence for the effects of confounding factors.

As is typical for meta-analyses on the effectiveness of interventions, there are several sources of bias in published training studies. First, there is a bias towards publishing studies or results from test instruments demonstrating significant gains after training. This may have led to the relatively small set of 24 studies over a 37-year period examining the effects of memory training using a randomized control design. Either it is difficult to publish the replication of an existing finding (publication bias) or the goal of most training studies is to demonstrate that individuals improve after training and determining the cause for the improvement is of secondary interest (as demonstrated by the relatively large number of excluded studies). As a consequence, published studies are more likely to report significant improvements after training. Despite publication bias, there are not many effects.

Second, there might be a bias towards overestimating effects by using the treatment for multiple comparisons with no contact controls and one or more active control conditions. Considering both types of bias and the few areas in which improvements were observed

after combination of data in a meta-analysis, even these improvements might be overestimating the actual chances of improvement through memory training interventions.

Several implications can be identified with respect to future research needs. Our analyses provide surprisingly little evidence for the effectiveness of memory training interventions in terms of significant effects and no evidence on their specificity. Considering that bias with regard to included studies might even be expected to lead to an overestimation of training effects, this argues against the effectiveness of memory training interventions. Despite the great interest in cognitive interventions, relatively few of the published studies use efficient designs to examine the effectiveness of interventions. Treatments differ widely between studies with respect to selection of participants, length of training and number of training sessions as well as materials used for interventions. Due to heterogeneity of procedures, dealing with absent training participants and a variety of training contents, content combinations, and matching of evaluation instruments to training contents, training effects might in fact be substantially larger and future research may profit from more standardized training protocols and outcome measures to allow pooling and comparison of studies. Furthermore, many training approaches include a combination of several elements, and individuals may respond differently to different training elements. Thus, training effects on an individual level may be substantially higher than the overall group effects. Therefore, future research taking more care to recruit homogeneous samples in terms of responding to the training or by collapsing data within individuals before aggregation on a group level might provide more appropriate tests of the effectiveness of cognitive interventions.

There are clearly more studies reporting the effects of training on rather basic abilities such as free recall than there are studies addressing more complex behaviors such as goal-setting, planning, or, in general, executive functioning. The ability to adjust the use of cognitive skills to perform higher order tasks may be better captured by focusing on individual learning trajectories rather than focusing on mean level changes. Furthermore, there are very few studies on the effectiveness of memory training interventions in individuals with mild cognitive impairment as defined by any diagnostic classification. Here, a consistent definition or agreement on core criteria of MCI may help in gathering evidence more quickly.

5 Application of a stability-oriented model of lifespan development to work context

5.1 Introduction

Individuals develop across lifespan and are in interaction with their environment and therefore exposed to internal (e.g., biological, age-related) and external changes (e.g., technology). This exposure varies within specific environments. Well-being, quality of life or life satisfaction are indicators for successful aging and are a result of the optimal adaptation of the individual to these biological, social and psychological changes. Along with the changes, individuals are challenged to re-orchestrate their resources and to stabilize an ideally already prevailing equilibrium. Prerequisite is knowledge of the relevant variables or influencing contexts (resources, adaptive potential, demands). For this adaptation, individuals use regulation mechanisms (cf. section 1.2).

Looking at the socio-demographic environment, a major change occurred over the last decades in demography: The term “aging pyramid” has lost its validity. In fact socio-demographic development rather resembles a “mushroom”, with middle agers composing the heart of the population. This demographic development is also persistent in organizations or work environments. The employment market already comprises fewer younger employees and an increasing number of older employees (50 plus); and this tendency is on the rise. At the same time, our contemporary work environment is marked by rapid changes and rising complexities from new technologies, competitive organizations and markets, new interactions and complex life roles. In order to survive in the competing markets, to meet client requests and needs, and to keep up with technological evolutions, age-related changes can play an important role, all the more so when they cumulate due to demographic changes in organizational staff.

In the literature, the interest in the aging workforce and in successful aging at work is constantly rising. Several relationships between age and aspects like health, performance, well-being, goal attainment, motivational structures, career and training issues have been studied. Research begins to link aging workforce and human resource management (HRM); and propositions on the consequences of demographic change for HR management have been formulated (Sterns & Miklos, 1995; von Cranach, 2004; Roth, Wegge, & Schmidt, 2007; Shultz & Adams, 2007; Korff, Biermann, Voelpel, Kearney, Stamov Rossnagel, 2009).

Comparatively sparse literature exists that links knowledge from lifespan psychology with work and organizational psychology as well as HR practices; the same applies for systematic guidelines on how to tackle the question of how to manage the aging workforce in organizations and of what are the relevant person-related and environmental factors and possible implications for individuals and organizations in a changing environment. My attempt to do this will be based on a stability-oriented lifespan model: The model of quality of life-management of resource-orchestration (cf. section 1.3). This model is based on lifespan development presumptions like coexistent variability and stability within one person (multidimensionality and multidirectionality) and puts the aging person, his or her goals (quality of life or well-being), competences, and possibilities and capacities for resource use to the fore. It supposes that a comparison of abilities between different ages only makes sense when considering their relevance for dealing with the different life tasks and challenges in different life phases and contexts (contextualism). This framework is chosen for this thesis because the model is comprehensive, because it is based on a resource- and person-orientation and on literature from aging and lifespan development, and because it considers the importance of person and contextual or environmental variables in order to obtain a person-context-fit (Zöllig, Eschen, & Martin, 2010; Martin & Kliegel, 2005). The latter term is also to be found in studies on work and organizational psychology or HR practices such as staff recruiting and HR development with the goal of having the right people at the right place in order to maintain optimal employee satisfaction and performance as well as high productivity of the organization (Hoffman & Woehr, 2006). So far the orchestration model has been applied in terms of a learning consultancy in order to enable individuals to become their own memory managers. It is posited here that it could serve organizations to become a tool for demography management.

The framework presented here will therefore examine theoretically the transferability of the model of quality of life-management of resource orchestration to work context, identify person- and context-relevant factors and offer propositions which outline potential relationships among these factors. It thus examines the following research questions:

1) What are stability-factors in work context?
2) What are relevant person- and context-relevant factors?
3) What are potential relationships among these factors?

5.2 Stability-orientation in work context

The stability-oriented model of quality-of-life management of resource-orchestration posits that an optimal orchestration of resources enhances individuals to pursue their goals like quality of life, life satisfaction or well-being. A fundamental challenge in the aging process is to create an individual fit between person-based resources and context-based requirements. According to this and looking at the individual in the work context, one may suppose that in the workplace, individuals strive for job satisfaction. There is literature indicating that job satisfaction is positively related to general life satisfaction and therefore stands as work related component of well-being (Rode, 2004). As we know though, there is equifinality in the attainment of job satisfaction because individuals are individually motivated by different variables and have various preferences and priorities, which are likely to change over the life course (cf. Carstensen, 1992; Kanfer & Ackermann, 2004; Zacher et al., 2009). Research on the relationship between age and job satisfaction show either a u-shaped form, indicating higher scores for younger and older adults than for middle aged adults or a positive linear trend indicating a continually rising job satisfaction with increasing age (for an overview see Schulte, 2005). It has to be considered though that there might be a selection bias, indicating that only satisfied workers work until retirement and unmotivated workers leave the organization way before.

The work context in which the individual operates usually is an organization or social system. Organizations are open systems that interact with their environment and are as well exposed to internal (e.g. humanization of work) and external changes (e.g. market, technology), which need be considered in order to remain performing and productive. Any changes outside the system (market, competition, customer needs, political or ecological systems) also act on the system and its members (Lauer, 2010). If the organization and its members want to adapt to these changes, regulation mechanisms have to be implemented. In change processes, there are driving (changing customer needs, technology) and restraining forces (fears, “historical memories” or habits, lack of resources) and the organization has to find equilibrium of the forces in order to remain competitive. Reorganizations and structural adaptation within the organization are often consequences of the impact of these variables outside the system.

From organizational or managerial point of view, employees’ job satisfaction is very important because there is evidence for a robust positive association between overall job

satisfaction and performance (Judge, Thoresen, Bono, & Patton, 2001). Furthermore, tenure of high performers and productivity, high commitment as well as competitiveness in the market, innovation and quality, etc., are other goals that employers seek to hold stable.

In the model of quality-of-life-management of resource orchestration, individuals pursue personally relevant goals like quality of life, life satisfaction or well-being.

Regarding goal achievement, one could assume that the bigger the entity, the bigger is the possibility for conflicting goals and interests. From change management we know that common goals of the organization and individuals in the organization are very important because they are beneficial for the stabilization of the equilibrium, whereas conflicting goals may enforce the restraining forces in a change or adaptation process (Lauer, 2010). Person-environment fit in work context is often referred to as person-organization (PO) fit. There is a lack of consistency in the definition of the concept but there is consensus that it involves compatibility between individuals and their organizations. Compatibility varies according to authors but involves among other aspects goal congruence, needs-supplies fit and demands-abilities fit (Hoffman & Woehr, 2006).

Lately, the discussion about quality of life has been dominated by health status in terms of physical and mental functioning; for instance, older people rate health aspects higher within their determination of quality of life than younger people do (Walker, 2005; Warr, Butcher, Robertson, & Callinan, 2004). The same trend is observable in organizations, where organizational health programs become more predominant because healthy employees are important for performance.

In summary, stability-orientation in work context aims at regulating relevant factors in order to stabilize person-organization fit in terms of goal consensus between individual and organization, needs-supplies fit, demands and abilities or personal resources vs. context demands fit which ideally contribute to stabilization of high performance and job satisfaction.

5.3 Person- and context-related factors

As indicated above, the identification of relevant person- and context-related variables is crucial in order to regulate internal and external changes and maintain equilibrium. The purpose of the section below is to identify them and to put them into a work context. Given the increasing mean-age of the workforce and following the question of how age affects HR

practices, age will be a person-related factor being discussed in further detail. But as seen in the introduction, lifespan development is marked by intra- and interindividual differences in cognitive functioning or health issues. Conceptualizing older workers by their age seems therefore problematic. Sterns & Doverspike (1989; cited in Sterns & Miklos, 1995) proposed five approaches to conceptualize older workers:

- Chronological age refers to calendar age;
- Functional age or performance-based age takes into account interindividual differences in cognitive abilities and physical health and is based on objective measures;
- Psychosocial age addresses the self and the social perception of age regarding the age of a person, their aging of knowledge or performance and is related to attributes and stereotyping.
- Organizational age bases on time spent in a position or organization and is discussed in the literature in relation to tenure, age-typing of jobs or age norms within a company.
- Lifespan age conceptualization contains also elements of the other four conceptualizations but adds the possibility to make change at any point in the lifespan; three factors influence behavioral change: 1) normative, age-graded biological, and/or environmental determinants which are strongly related to chronological age; 2) normative, history-graded influences and cohort effects; 3) non-normative, individualized career and life changes such as family status or career stages.

This conceptualization seems very useful in order to stress the need for a differentiated approach of age or of the aging worker; yet the conceptualizations are often not selective but interrelated. Cleveland & McFarlane Shore (1992) used person- and context-oriented definitions of age to predict work attitudes, performance ratings, and reports of developmental practices. The five age measures included employee chronological age, employee subjective age (i.e., self-perceptions of age), and social age (i.e., others' perceptions of age), as well as self- and supervisors' perceptions of the employee's relative age (i.e., compared with the employee's work group). They found interrelations between the age-definitions; for example, employees with high subjective age perceptions exhibited more job involvement, job satisfaction, and organizational commitment. With this

interrelation in mind, the following section will use these age conceptualizations in order to identify other relevant person-related factors and context-features in work context.

5.3.1 Chronological age

The distinction between younger and older workers is often made by chronological or calendar age although there is little theoretical justification for this. There are some justifications for age ranges deriving from American law such as the Age Discrimination in Employment Act (ADEA), protecting workers over the age of 40, or the Americans Disabilities Act (ADA) protecting any worker with a disability. Chronological age often indicates time for retirement. Research has shown that older people's well-being is a function of employment, retirement, environmental characteristics and role performance (Warr et al., 2004). In terms of development activity, Maurer, Weiss, & Barbeite (2003) developed a model of involvement in work-related learning and development activity and age variables. They found some significant but rather small age effects indicating that older workers receive less support for development and generally possess fewer individual characteristics that could enhance development. Older workers reported feeling less cognitively able and having lower perceptions of themselves as possessing learning qualities. These findings are generally consistent with both stereotypes and data on the actual functioning of some cognitive processes.

More relevant than calendar age are biographical issues in the sense that unfavorable habits or dysfunctions in older age are more a product of biographical development or historical influencing factors than of increased chronological age (Martin & Kliegel, 2005). Looking at context-features affecting this person-factor, the chronological age of reference groups such as co-workers or supervisors needs to be taken into account as shown by research from Shore, Cleveland, & Goldberg (2003). They studied work attitudes, performance and developmental experiences as a function of manager age and employee age, and found support for the fact that managers and employees may view age differences differently. Regarding employee-rated performance, younger employees had highest ratings when their manager was young and lowest ratings when their manager was old. This indicates that age differences in the manager-employee-dyad seem to have negative effects for younger and older employees. Younger managers evaluate younger employees regarding potential and promotability higher than they evaluate older employees, whereas older managers rate younger and older employees similarly. Along with this finding goes that older

managers treat older and younger employees similarly, but younger managers provide much more development opportunities to younger than to older employees. The importance of the role of co-worker's age is studied in the literature through the question of advantages and disadvantages in age-mixed teamwork. Wegge, Roth, & Schmidt (2008) give an overview and found: No effects of age-diversity on performance in top-management-teams or sport-teams; no direct effect of age-diversity on performance in product-development-teams, but significant negative correlations with emotional and cognitive conflicts; no or no significant effects in student-teams on group performance; age-mixed teams in the service-sector were more successful because task demands were complex. All in all, age-diversity in teams can be linked to positive as well as to negative effects and age-mixed teams work better when age is not a salient factor in self-perception and when the older worker experiences positive appreciation.

5.3.2 Functional age

Functional age is a performance-based approach of the worker. Warr (1993) proposed a theoretical four-category framework to describe in what circumstances work performance may vary with age. He expected only a negative relationship between performance and age in activities that include continuous, rapid information-processing, rapid learning, and strenuous physical activity (age-impaired activities). Activities that require skilled manual or cognitive tasks or knowledge-base judgments with no time pressure and which can be enhanced by relevant experience or compensate decline are not expected to have a relationship with age. This approach stresses the importance of considering the nature of work tasks when wanting to make assumptions about the relationship between age and performance. In order to maintain performance stable, age-differentiated job and workplace designs are important for interventions. Furthermore, changing environmental demands and work contexts, fast technological development, and short-livingness of products and working material and increasingly competitive marketplaces increase the importance of high-performing employees, high adaptability and put learning skills to the fore (Hall & Mirvis, 1995). The need for continuous learning rises and formal learning competences of older adults have been studied above all in cognitive trainings (see chapter 4). Plasticity and learning is possible until old age and some recommendations for learning facilitation in old age such as the use of familiar information, no time pressure, exercises, practical reference, or structuring of learning material have been proposed (Martin & Kliegel, 2005; Sonntag &

Stegmaier, 2007). Besides formal learning in education and training interventions, informal learning competences of older workers have been studied (Stamov, Schulz, Picard, & Voelpel, 2009). These on-the-job-learnings are of great interest for organizations because they are not necessarily linked to additional costs and can take place through new and challenging job assignments that push employees out of their comfort zone or by systematically trying new procedures (learning by doing), reading a job-related book or getting advice from work-colleagues. Results showed that in on-the-job-learning, a person-related factor like memory self-efficacy, meaning the judgment of one's memory ability, is an important driver of learning success (keeping with the schedule, ability to transfer learnings to the workplace) and acts on learning control (ability to set learning goals and monitor one's learning progress). Context-factors such as learning climate, learning opportunities and age stereotypes play an important role in this. An overview on the cognitive development and plasticity across middle adulthood as well as the influences of context-factors like education, lifestyle and work environment was given in chapter 0 (Martin, Zehnder, & Zimprich, 2008; Armstrong-Stassen & Schlosser, 2008).

The consequences of aging on functional aspects such as performance or health are often marked by stereotypes. Stereotypical thinking or behavior (in organizations) is a subject that will be discussed in more detail in the following section.

5.3.3 Psychosocial age

Psychosocial age refers on one hand to *subjective age*, meaning how old a person feels, acts and with which age cohort the person identifies him- or herself and how a person accepts the own age or how old a person desires to be. Self-perception about the own age may have an influence on how to perceive others individuals, meaning that someone who has difficulties with his own age(ing) may project these attitudes towards others in the same age group. A study of Maurer, Barbeite, Weiss & Lippstreu (2008) is one of the few studies investigating how stereotypes held by aging workers relate to behavior by the aging workers themselves. Those senior employees (mean age=50.35; SD=7.81;) who held greater beliefs that older workers lack ability and desire to develop would also be more likely to feel more favorably toward retirement and would be less likely to possess interest in pursuing learning and development activities themselves. Results underline also the importance of managing personal experiences and knowledge about increases/decreases in abilities across lifespan because they are antecedents of stereotypical beliefs and associated behavioral constructs.

On the other hand, psychosocial age refers to the *social perception* of age, the social attitudes, stereotypes and behaviors held toward older workers, for instance regarding job performance, skills, job typing (i.e. age and having a CEO position) or career perspectives (Sterns & Miklos, 1995). According to a meta-analytic review of Kite, Stockdale, Whitley, & Johnson (2005), most common negative stereotypes towards older adults are lower willingness to engage in developmental activities, lower competence, lower adaptability or resignation to change, higher sickness risks, lower performance and lower attractiveness, whereas most common positive stereotypes are experience, loyalty, sense of responsibility and wisdom. Picking out and responding to two of these stereotypes, namely health issues and wisdom, there is evidence that the incidence of injury among older workers is lower than among younger workers but that once older workers are injured or sick, there is greater prospect of long-term disability and recovering time which may lead to longer absenteeism (Hansson, DeKoekkoek, Neece, & Patterson, 1997); regarding wisdom, having lived longer is not in itself sufficient for acquiring more knowledge and judgment capacity in the wisdom domain (Baltes & Staudinger, 2000).

Kite et al. (2005) found evidence that attitudes toward older persons are more negative than attitudes toward younger persons and that context provided for the ratings moderate the results. Extensive positive information provision diminishes age differences for the category competence (e.g. intelligent, good memory) and evaluation (e.g. generous, friendly). Respondent age may also play a role in that middle-aged respondents assess younger adults more positively than older adults in terms of competence and evaluation of these groups. This underlines the findings that attitudes toward the old-old (75 and older) are more negative than attitudes toward the young-old (55-64). Younger raters (<30 years) rated younger workers more favorably than older workers (30-60 years) in terms of the workers' job qualification, potential for development, and qualification for physically demanding jobs. Middle-agers (36-54) showed the largest age-related bias. This is consistent with in-group bias, meaning that raters from an age group rate members from the same age group more favorable than members from another age group. But this was only true for the younger age group, since older raters did not show an in-group bias in favor of their own group, suggesting that older adults do not as heavily rely on stereotypes as younger adults (Finkelstein, Burke, & Raju, 1995; Kite et al., 2005).

If older workers adapt this viewpoint and internalize such stereotypes, e.g. doubting their competences, this could influence their behavior in various ways. For instance, a lack in support and encouragement as well as exposure to age stereotypes and beliefs about decrements with age may contribute to a decline in perceived self-efficacy for development of career-relevant skills and voluntary participation in learning or development activities relevant to work. Also, beliefs that older workers are neither able nor interested in learning and development might influence senior employees' intentions to retire (Maurer, 2001; Wrenn & Maurer, 2004; Maurer et al., 2008). Therefore, preventing stereotypical thinking and acting is a very crucial managerial task that must be actively counteracted by organizations and superiors.

Context-factors lie in teams compositions, supportive development climate for older workers and in creating a work environment that is either free from stereotypical thinking and acting or a work environment in which age-related factors are taken into account but in which age is not a salient factor but other characteristics of a person such as their competences come to the fore (Finkelstein et al., 1995; Armstrong-Stassen & Schlosser, 2008).

5.3.4 Organizational age

Organizational age refers to the aging of individuals in jobs and organizations and is discussed in the literature in relation to tenure, age-typing of jobs or age norms within a company. As demographic changes also predominate in organizational context, many companies face increasing mean averages of their workforce, and unbalanced age-distributions in the workforce, possible mass retirements and know-how-losses become relevant topics for organizations. Chronological age and *tenure* are often closely linked.

Social perceptions may also become important in this perspective, because an organization may be perceived as young or old because of the age average of its members. Above all, with the challenge to attract younger employees, this may have implications on marketing issues. Age distributions and age stereotypes in organizations may influence age norms and organizational culture. Findings support that organizations with little turnover show more widely shared organizational age norms such as norms for typical age at career levels and expectations regarding promotion decline with age (Lawrence, 1996).

Along with organizational age, job changes, influence of experience and retirement are relevant issues. Research on *career changes* in midlife shows that they are inhibited by

perceived risk-taking, by the impression to start at the bottom, not being able to build on past job-experiences and by career contracts that have been built with increasing organizational age and that need to be reviewed and possibly renewed (Hall & Mirvis, 1995). Avolio, Waldman, & McDaniel (1990) found that age, performance and experience in present job and with present employer interrelate; in line with previous findings, they found that length of *job experience* was a better predictor of work performance than was age. The findings showed a modest moderating effect for occupational type (clerical jobs, craft jobs, service jobs) in that both age and experience predicted performance better for jobs requiring higher levels of complexity or mastery than other jobs. Maurer & Weiss (2010) investigated the role of age and experience for continuous learning skill requirements. They found experience to be a unique predictor of continuous learning skill requirements, whereas age was not, when controlling job and experience. On the context-side, certain job task dimensions like information gathering, decision-making, dealing with subordinates, technology, company services and networking seem particularly associated with high need for continuous learning competences and have to be taken into account when analyzing these relationships.

With the baby-boom generation approaching the traditional *retirement age*, mass retirements are likely to occur. The importance of role preference, meaning being able to choose the time for retirement, has been stressed in the literature and several influencing factors on the retirement decision such as financial situation, satisfaction with one's employment intentions and anxieties about separation from the workplace have been identified (Hansson et al., 1997; Warr et al. 2004).

5.3.5 Lifespan age

Lifespan age adheres to elements of the other four conceptualizations but adds the lifespan perspective, which is that change is possible at any point in the lifespan (cf. section 1.1.1). Three factors may influence behavioral change: 1) normative, age-graded biological, and/or environmental determinants which are strongly related to chronological age; 2) normative, history-graded influences and cohort-effects; 3) non-normative, individualized career and life changes such as family status or career stages (cf. chapter 1.1.2).

Lifespan approaches have not only been studied in relation to cognitive development but with many other psychological constructs such as emotional regulation (Carstensen, 1992), work motivation (Kanfer & Ackermann, 2004) or personality traits (Fraley & Roberts,

2005). Graf (2007) promotes a life-cycle approach in training and development with the goal of maintenance and promotion of high performance and willingness to perform during the whole organizational life-cycle by taking into account changes in biosocial, family, work, organizational and job life cycles. For instance, learning may be supported more effectively by synchronizing overarching learning demands e.g. in the wake of promotion with workers' life events in order to benefit from off-the-job motivation peaks (Stamov Rossnagel et al., 2009).

Job or career life cycle has also been explicitly related to expectations of own profession, expectations of management and expectations of work community (Ylikoski, 2000; cited in Ilmarinen, 2005, p. 108), see Table 8. The linkage between phase of life and expectations is consistent with the assumption of changing motives over lifespan; it has to be taken into account though that individuals will not necessarily be able to follow such single careers and trajectories and probably will run through the same phase more than once and will be able to make change at any point (Sterns & Miklos, 1995).

The lifespan approach provides a holistic point of view of the human being within its context. Human resources policies should reflect the potential for employees to experience positive growth at almost any time in their work-life and focus on the worker's ability and expertise. In learning context, the need for considering learning biographies goes along with this, including past learning behavior and experiences as antecedents of self-efficacy and skill development activities (Maurer, 2001).

Table 8: Employees' expectations of their profession, management and the work community in different phases of work life.

Phase of life	Student	Learning worker	Competent professional	Experienced instructor	Helping wise ones
Age (about)	<20 years (25 years)	25–30 years (35 years)	35–45 years (50 years)	45–50 years (55 years)	>50 years (55 years)
Expectations of own profession	– to take one's time learning – to attempt to find one's special areas in safe challenges and even under pressure	– to tutor newcomers – to implement independently and to sometimes even fail – to specialize and focus	– to be able to give advice and guide – to qualify in a broader and more profound sense – to use one's entire expertise	– to mentor, train and be of help at work by teaching – to manage entities	– to alleviate – to transfer wisdom and experience – to open new horizons and perspectives
Expectations of management	– to be coached – to be given mature support – to be guided and included – to be prepared to "let loose" and question	– to be given authority – to be given more economic and management responsibility – to be given the opportunity to learn to lead and contribute to a partnership	– to be given responsibility – to be given broader overall responsibility of even substantial matters – to be included in decision making and the inner circle of knowledge	– to be appreciated – to be given attention and the responsibility for preparations – to be understood in different life situations – to set stop signs and limits	– to be consulted – to be given respect – to be offered feedback – to make use of one's connections and visions
Expectations of the work community	– team work – acceptance – expertise	– to be given the opportunity to lead a group and to receive acceptance – to experience changing roles	– creative team work – communication and brainstorming with others, team success	– supportive solidarity and an atmosphere of openness – maturity and responsibility for one another	– to be kept as part of the group – to be given space

5.4 Implications for work and HRM

The identification of relevant person- and context-oriented factors within a differentiated age conceptualization framework offers several implications for work and therefore also fields of action for human resource management.

Organizations, which focus on the chronological age of their workforce, need to take into account biographical issues, cohort-effects and team compositions. In order to know about the organization inherent age structure, *age structure analysis* is recommended as a base for age management, for defining fields of action and for implementing the adequate strategies and measures. This is also crucial in terms of a financial point of view, because age

structures also have implications on *personnel costs* because salaries and fringe benefits are usually related to age and experience. Furthermore, an *analysis of team compositions* may be recommended in order to prevent mass retirements and know-how losses.

Person- and context-oriented factors linked to functional age demonstrate the necessity for *health prevention*, provision of on- and off-the-job learning and *training opportunities* as well as *job and workplace (re)engineering*. On the person-related variables, it is important to strengthen self-efficacy because it is an important determinant for subjective ability in cognitive functioning or learning capacities. Again, it is important to take into account learning or physical biographies and provide support and encouragement to all employees about learning and development capacities (Maurer, 2001). Organizations should think about measures in order to guarantee work ability and health such as competence development, pause and regeneration management, work time models, work conditions and workplace (re)engineering. Strain from physically demanding, wear-out- and routine-jobs needs to be limited through systematic task changes, rotations or even job changes (Ilmarinen, 2005; Frieling, Buch, & Weichel, 2008; Roth et al., 2007).

Taking into account psychosocial factors of the workforce, stereotypical beliefs about oneself and others can affect behavior in terms of groups' dynamics, recruitment, performance approvals or subjective memory performance or self-efficacy. In these cases, provision of information about the target, as well as other systematical *educational advertising and sensitization* may help to diminish perceived differences between younger and older individuals. Sensitization could entail building awareness and acceptance in organizations about lifespan development, differences in performance, speed, accuracy, and style in learning experiences. Furthermore, it could entail raising awareness in managers, executives and career counselors of age stereotypes and raise consciousness of when stereotypes may be influencing assumptions and decisions in order to reduce ageism and prejudice in organization culture (Kite et al., 2005; Maurer, 2001).

Implications from organizational age stress the importance of personal role preference, meaning the possibility to choose the moment of retirement and the importance of environmental characteristics like health or financial status (Warr et al., 2004). Another challenge for organizations and individuals is to keep motivation high, above all in high tenure employees (Kanfer & Ackerman, 2004). Experience and know-how use in

highly complex jobs is especially important for organizations and may be managed by age-heterogeneous work groups or mentoring systems (Roth et al., 2007).

The lifespan perspective integrates the former, interdependent conceptualizations and adds the lifespan point of view to them. These interdependences between the conceptualizations may be beneficial or be a strain. Not only individuals should be looked at from a lifespan perspective; organizations may also have life cycles and own product cycles. Overlapping life phase activities like starting a new job or launching a new product and entering family phase (e.g. birth of a child, marriage) might require more time and energy than currently available. Re-orchestrations of resources and new priorities and goals may lead to engagement reduction in some activities. Implications for HRM lie therefore in being aware of such interdependences and furthering self-management of employees, emphasizing to look at the individual within his different contexts and life phases (Graf, 2007).

By orchestrating these person- and context-oriented factors in many different individualized ways, organizational stability factors like job satisfaction, productivity or commitment may be enhanced. **Table 9** summarizes the above-described relevant person- and context-oriented factors within the age conceptualizations and their implications for work.

***Table 9**: Overview on person- and context-related factors within age concepts*

Age concept	Relevant person-related factors	Relevant context-related factors	Implication for work
Chronological	○ biography	▪ historical factors ▪ age of co-workers ▪ age of supervisor	➢ age structure analysis ➢ team compositions (i.e. age-mixed teams vs. age-homogenous teams) ➢ supervisor ratings ➢ salary implications ➢ retirement models
Functional	○ cognitive performance ○ physical performance ○ plasticity ○ (wisdom) ○ lifestyle ○ education	▪ work environment (task complexity) ▪ learning environment	➢ training/lifelong learning ➢ dealing with performance decline in physical jobs ➢ health prevention ➢ stimulating work conditions ➢ pause/regeneration management ➢ work time models
Social	○ self-efficacy ○ subjective age ○ attitudes towards own age	▪ type of job ▪ characteristics of co-workers ▪ age of supervisor ▪ age discrimination culture	➢ job selection ➢ selection und encouragement for training issues ➢ performance ratings ➢ culture/stereotype management
Organizational	○ experience	▪ organizational age norms (attitudes toward older workers, being behind schedule) ▪ job-typing ▪ tenure	➢ retirement models ➢ salary policies ➢ know-how transfer ➢ organizational development/ culture management
Lifespan	○ roles / role complexity in different life phases ○ goals/priorities/ motivation ○ personality	▪ environments and life phases such as family, organization, social networks, biological influences etc. ▪ influences bound to calendar, functional, social, and organizational age	➢ life cycle HRM ➢ motivational/reward systems ➢ talent management ➢ career planning ➢ employability management ➢ coaching ➢ communication

5.5 Conclusions

The aim of this chapter was to theoretically examine the transferability of the model of quality of life-management of resource orchestration to work context by identifying stability-factors, person- and context-relevant factors and by offering propositions about potential relationships among these factors.

Transferring the person-oriented orchestration model to a bigger social entity (such as an organization) and to a specific context (such as a work) gives fruitful insights but also has some limitations. In general, advantages of applying this model to work context lie in the systematic identification of person- and context-relevant factors in order to maintain equilibrium. In terms of the *stability-orientation*, it seems important to align individual and company goals and to build awareness that goals evolve along with the development of both the individual and the organization. On the other hand, the possibility of conflicting goals has to be taken into account. This is also addressed in the person-organization fit inherent compatibility of need-supply, abilities-demands or goal congruence. When a certain level of compatibility is reached between the individual and the organization, there may be a strong chance for reaching goals such as job satisfaction and performance.

Person-related factors have been outlined on the base of the age conceptualization and several relevant variables that interrelate and that relate with the environment (self-efficacy, plasticity, biographical features, favorable subjective perception of psychosocial age, and active persecution of individually relevant goals) have been identified. Characteristics of the environment were identified as *context-factors* and can be summarized on the social level (co-workers, colleagues, reference groups), task level (changing job demands), organizational level (organizational culture, structures, strategy), and outside the system (market, political, ecological, or economical system). The latter (changes in the market, customer needs, demography, political situation, technological development) were not explicitly discussed but they may also come into the picture as for instance customer needs may be marked by the demographical development. These factors external to the system have to be integrated in analysis because they all act on organizational structures, strategy, job demands and the staff.

It must be the aim of employees and employers to identify the resources within the person- and context-factors in order to find several ways to orchestrate them. The identified person- and context-related variables have not been categorized as resources, abilities,

changes or demands because their development is multidimensional and multidirectional and would need to be assessed individually. Dialogue and renewing psychological contracts may enhance this process. The model does not give explicit guidance on interrelations and causality of the variables but it is an inventory of variables that might play a role in stability-oriented organizational demography management. It should be the responsibility of the individuals and the organization to orchestrate them in a fruitful way and puts self-management of the individual to the fore. According to equifinality, many means and combinations of means may lead to the desired state.

In summary, several processes and variables that may take effect within the model have been identified. First, to the extent that researchers and HR practitioners have a better insight and understanding of relevant factors contributing to stability of organizational functioning, their ability to manage and modify these factors is strengthened. Second, it may help organizations to assess whether they are prepared for upcoming developments and trends like demographical and strategic changes and to identify needs for action. Third, it can also serve as an analytic instrument and therefore contribute to the as-is analysis, detect challenges and need for action and set the course for (HR) interventions - given that the goals are clear. Fourth, the model has a preventive character as it includes regulation mechanisms, which constantly stabilize the system as it supposes an already existing equilibrium of the desired state.

Besides these advantages, there are some limitations. The proposed framework is a general framework and not branch- or company-specific. It demonstrates an approach of person- and context-oriented factors that are relevant for organizational stability considering a steadily developing individual within a constantly changing organization. It is limited in its level of detail orientation, meaning that it remains on a general level and does not explicitly outline an action plan for different organizations in specific branches with specific presumptions. Of course, an IT organization, presumably a rather young organization, has other socio-demographic predispositions than a (former) state-owned company with rather minimal fluctuation. Industrial organizations with larger percentages of low-educated employees have other challenges than companies with highly educated employees. For a sound analysis, it is crucial to take into account differences in market situation, job or employee characteristics. Furthermore, although implications for HRM have

been formulated, more detailed practical interventions within HR processes are missing and questions about their practicality remain open.

From a methodological point of view, the model is not empirically tested and does not address causality; single interrelations between the variables have been identified, but different constellations of employees, job structures, market changes and so on lead to different interrelations of the variables and the model becomes highly complex. This makes it very difficult to depict all these interrelations and at the end measure them; further research is needed to fathom this out.

6 Towards a stability-oriented model for organizational demography management

6.1 Introduction

There is a consensus in literature that there is and will be an increasing number of organizations experiencing the aging of their workforces. Some prevalent strategies organizations use in order to counter this trend are 'rejuvenating cures', i.e. hiring young employees and pushing early retirement. These strategies are limited by a decrease in potential of hiring young qualified employees because of demographical development on one hand, and by a trend to extend work life phase by increasing retirement ages on the other hand. Furthermore, there are branches that experience the contrary, namely a lack of seniority. Organizations need to focus on what they 'have' and need to adjust their strategic spectrum. Strategic human resources management research provides evidence for a positive association between HR practices and organizational performance, and researchers begin to link HR practices, aging workforce and lifespan approaches. But the question of how aging and changes in individual development across lifespan, environment and goals affect HR practices at the individual and organizational level is still rarely addressed (cf. Korff et al., 2009; Hansson et al., 1997; Roth et al., 2007; Vaupel, 2010; Ilmarinen, 2005).

The purpose of this section is to find out what implications a differentiated approach of age has for HR management and what possible measurement instruments are in order to regulate a changing demography in work context. Therefore, the following research questions have been formulated:

1) How can stability as well as person- and context-related factors be measured?

2) How can these factors be regulated through HRM?

A stability-oriented lifespan model of resource orchestration was theoretically transferred to work context in the previous section in order to approach these questions and identified relevant person- and context-related variables, stability factors as well as fields of action for HR practitioners. Now, corresponding measurement instruments and possible regulation through HR practices for successful aging in organizations will be tackled in order to contribute to a deeper understanding of the proposed framework of dynamic stability of individuals and organizations. We will use an interdisciplinary approach of lifespan

development psychology, work and organizational psychology as well as HR practices to approach this. Although measurement and regulation of person- and context-related variables is often closely linked, variables will be discussed separately in order to take up the formal and proven systematic approach of the previous chapter.

6.2 Measurement of person- and context-related variables

Since individual development and environmental changes as well as the interaction of both is dynamic, measurement of these changes as well as regulation mechanisms are of special interest here. In our model, different aspects of measurement of person-related variables become relevant: measurement of the variable at a current state (e.g. baseline), measurement of potential for change (plasticity), and measurement of change (or stability). Measurement of potential for change or plasticity is very important in this model as it stands for a potential for regulation. The need for regulation on the other hand rises with the outlined increase in inter- and intraindividual variability in person-related variables across lifespan (e.g. cognition) and an increase in complexity of context (e.g. task complexity).

The change and stability literature discusses different measurement approaches: 1) changes (or stability) through variability in behavior (inter- and interindividual variability), 2) changes (or stability) through lifespan development or 3) changes (or stability) through interventions such as HR practices (Willett, 1997; Eid, Geiser, & Nussbeck, 2008). Carrying these approaches over to context-related variables would therefore include measurement of change (or stability) in (work) situations and (work) context, change (or stability) in lifespan demands (e.g. roles, career stages and associated expectations), or changes (or stability) through interventions such as HR practices. With these approaches in mind, the following section outlines measurement of person- and context-related variables.

6.2.1 Person-related variables

Relevant person-related variables - which may or may not function as resources - have been identified in chapter 5.3 and included abilities, motives, goals, attitudes (e.g. about subjective memory self-efficacy or self subjective age), personality, biographical variables regarding learning, experience, education, health, roles, or lifestyle. Some of them will be exemplarily discussed in further detail in terms of how they could be measured.

In *cognitive functioning and performance*, subjective measures play an important role. Self-referent beliefs about functionality of abilities may act as predictors in measurement of cognitive functioning. One of the dimensions bound to self-referent beliefs is memory self-efficacy, defined as the level of confidence a person has in the effectiveness of his or her own memory in different situations. These subjectively perceived changes in functionality might contribute to the assessment of memory self-efficacy or feelings of knowledge through questionnaires (e.g., MFQ, MIA, or MSEQ). Older people tend to report less control over their memory functioning, believe their memory has declined more over time and report lower levels of memory self-efficacy (Hertzog & Hultsch, 2000). These beliefs may be somewhat resistant to modification as there is evidence that memory training has more impact on objective measures than on subjective memory assessments (Floyd & Scogin, 1997). Objective measures for assessing cognitive functioning are neuropsychological test batteries that cover various cognitive dimensions such as memory, executive functioning, or attention (cf. outcome variables in chapter 4.3.). Regarding work *performance*, Ilmarinen (2005) introduced the construct of work ability can be assessed with the work ability index (WAI) proposed by Ilmarinen (2005) and entails person- and context-related items on health (symptoms, functional capacity), competences (education and skills), values (joy of work, enthusiasm), and work features (strain, autonomy, support, demands, possibilities for development). In work context, supervisors assess performance by annual 'performance appraisals' –they are indirectly subjective and may be biased by stereotypical thinking of supervisors (Cleveland & McFarlane Shore, 1992). Assessment centers are a valid method for the assessment of relevant skills, given that they are competence-based. They give organizations a picture on how well individuals fit into a (changing) context - a position, team or organization. Physical performance or health may be measurement with a fitness index or with organizational data about absenteeism. All in all, it is crucial to oppose objective instruments to subjective ones, as the results obtained from these instruments may significantly differ. Cognitive functioning and performance are person-relevant variables that are very well researched in terms of the outlined measurement approaches. Besides current states of abilities, plasticity as well as changes through interventions are often assessed, as will be explained in the next paragraph.

Plasticity or malleability of cognitive and physical abilities is usually measured in cognitive trainings with pre-/posttest designs (two wave data) and follow-up data (multi

wave data) in order to determine long-term effects (see chapter 4). As discussed in chapter 3.1, cognitive functioning in middle age is not only marked by stability but also by different changes within and across cognitive abilities. Therein, different types of change (or stability) have been outlined: differential, structural, absolute, general versus specific, change of divergence and intraindividual variability; but since they refer to groups of persons, they might not capture the change of any individual (Martin & Zimprich, 2005). In HR practices, testing-the-limits in skills performance is closely linked to measurement of skills' potential for development and to talent management. Potential may be assessed by other methods than assessment centers such as for instance structured employee interviews, employee portfolio analysis basing on performance and potential, or management audits. All these instruments have in common that they base on requirements analyses, which are the fundamental base for every potential analysis (cf. Kliegl et al., 1989; Rohrschneider, Friedrichs, & Lorenz, 2010).

Researchers conceptualize learning within organizations in many ways and its assessment is therefore not quite easy. Usually, within the HR field, the question is whether learning aims at developing the individual and the organization (learning perspective) or primarily aims at meeting organizational goals (performance perspective). Within learning, there is a distinction between formal and informal learning. Formal learning (off-the-job such as training courses, seminars) is assessed with knowledge tests, simulations or case studies and ideally should include measures to assess transfer to practice and work performance. Informal learning in the workplace (work-based, on-the-job learning such as mentoring, job rotation, coaching, special projects or assignments, systematically trying new procedures, reading a work-related book) is usually more *ad hoc* and more difficult to assess (Clarke, 2004). Stamov Rossnagel et al. (2009) measure informal learning competency of employees through a questionnaire-based assessment of training participation, learning success, learning motivation, learning climate, opportunities at work, as well as memory self-efficacy. Clarke (2004) investigated means of assessing on-the-job learning in the workplace in specialized healthcare organizations and found that methods like appraisals, personal development plans, counseling and supervision, workplace diaries, learning fora, or guided reflection during team meetings figured prominently within these organizations. He also found that organizational factors like organizational size, paid study leave and possessing a training strategy influence the assessment of formal learning, while the presence of a senior

manager with responsibility for training and development as well as and the use of personal development plans were the key variables related to the assessment of informal learning. However, this research gives interesting insights about the use of informal learning methods but does not make any indications on the qualitative aspect of learning; the focus in the literature is not on the outcome variable but rather on the assessment of learning conditions and opportunities on the individual, organizational and task level. This signals that measurement of learning and learning environment are closely intertwined but further research is needed to tackle this relationship with more concise instruments.

The difficulty to identify cause-and-effect relationships in learning or to avoid comparisons between "apples and oranges" has also been addressed in the training transfer research. Barnett & Ceci (2002) offer a taxonomy for transfer which includes the dimensions 'content' and 'context'. *Content* refers to what is transferred and can be grouped into different types of skills along a continuum from specific to general; improvements on these types of skills can be measured in speed, accuracy, or simply in doing the right thing. The authors also suggest that the demands of the task may affect transfer success and may need to be explicitly considered. *Context* refers to when and where something is transferred from and to somewhere regarding knowledge domain, physical, temporal, functional, social context and modality (e.g. visual, auditory, written or verbal) and they differentiate between near and far transfer within each dimension (see Figure 4; cited in Barnett & Ceci, 2002, p. 621). However, this taxonomy does not make any sharp quantitative predictions but may be helpful to HR practitioners to clarify the question of assessment of learning or training transfer. In general, specification of *a priori* expected outcomes may facilitate the evaluation of training and development but further research on qualitative studies is needed to understand more about the impact of training processes.

In research of *work experience*, we find the same trends mentioned in the above paragraph. Experience is usually measured quantitatively in years spent in a job, position or organization and can be understood either as a basis for learning or as a way of learning. Qualitative measures have received relatively little attention. These include opportunities to development new knowledge and skills through training, mentoring, feedback systems, or supervision in varied, broad and complex tasks; furthermore, personality traits such as openness to experience may also play a role in this (Baltes & Staudinger, 2000). Possible instruments for measurement are the Developmental Challenge Profile (DCP) that measures

on-the-job situations and events that are associated with learning and managerial development, critical incident technique (CIT) or (semi-)structured interviews (Paloniemi, 2006; Tesluk & Jacobs, 1998; Avolio et al., 1990).

A Content: What transferred

Learned skill	Procedure	Representation	Principle or heuristic
Performance change	Speed	Accuracy	Approach
Memory demands	Execute only	Recognize and execute	Recall, recognize, and execute

B Context: When and where transferred from and to

	Near ←				→ Far
Knowledge domain	Mouse vs. rat	Biology vs. botany	Biology vs. economics	Science vs. history	Science vs. art
Physical context	Same room at school	Different room at school	School vs. research lab	School vs. home	School vs. the beach
Temporal context	Same session	Next day	Weeks later	Months later	Years later
Functional context	Both clearly academic	Both academic but one nonevaluative	Academic vs. filling in tax forms	Academic vs. informal questionnaire	Academic vs. at play
Social context	Both individual	Individual vs. pair	Individual vs. small group	Individual vs. large group	Individual vs. society
Modality	Both written, same format	Both written, multiple choice vs. essay	Book learning vs. oral exam	Lecture vs. wine tasting	Lecture vs. wood carving

Figure 4: *Taxonomy of far transfer (by Barnett & Ceci, 2002, p.621)*

Regarding measurement of personal goals, Zacher at al. (2009) measured goal achievement planning in the individual, goal emotions (how individuals feel by working on a certain goal), and goal specificity using questionnaires; the authors also considered job characteristics like task complexity and scope of action through the application of task analysis instruments in order to control their influences on goal characteristics.

In summary, taking into account environmental characteristics in measuring person-related variables is prevalent in literature: measurement of the selected person-related variables focuses on the outcome variable itself, by controlling for environmental characteristics, or – very often - by measuring (un-)favorable conditions for the variable.

Furthermore, measurements may entail different measurement levels. That is, taking the example of measuring workplace learning, assessments may be grouped into individual factors (learning capabilities and potential), organizational structures and provision of training and development within the organization as well as into job or task characteristics facilitating or impeding training and development. A more systematic approach addressing these levels consistently and taking into account measurements of current states and measurement of changes is needed; in addition, future measurement instruments should emphasize rather qualitative than quantitative aspects of some relevant person-related variables like learning or experience.

6.2.2 Context-related variables

As seen in section 1.1.2, development is marked by the dialectical interplay of age-graded, history-graded and non-normative changes (Baltes, 1990; Baltes & Lang, 1997). These contextual changes are in a constant interplay with the individuals and may dialectically originate from or impact the (a) outside of the system (market, political, ecological, or economical system), (b) organizational level (organizational culture, structures, strategy), (c) task level (changing job demands), and (d) individual level (co-workers, colleagues, reference groups). Measurement of context-related variables also addresses these levels.

Some *age-graded sources* of changes and their measurement have been outlined within person-related variables in the previous section. Some *non-normative*, contextual changes outside the system like ecological disasters or financial crisis are hardly predictable and may have great and impact on the whole organization, their structure and their individuals. *Normative, history-graded* influences and cohort effects are most likely detectable through longitudinal studies with baseline, pretest and posttest measurements. Social, political, economical, ecological, or technological situations and changes outside the organizational system may be measured through analysis of these environments. That is, age structure analysis in society and organizations as well as inventories about educational background may help to get more information about educational biographies, co-workers, and other reference groups. In work context, there are organizational statistics and annual business reports for some context-related variables, which are valuable sources for analysis. For instance, technological change is usually measured by its influence on the individual, organizational and task level and can be seized through long-term human capital planning (e.g., consequences of automation processes on headcount) or through work analysis

instruments (e.g. Job Diagnostic Survey (JDS) or Job Rating form (JRF), Fragebogen zur Arbeitsanalyse (FAA), Tätigkeitsbewertungssystem (TBS)). There are work analysis instruments with different focus such as health or stress aspects (e.g. SALSA, ISTA) or on how environments foster learning (cf. Frieling & Buch, 2007; Frieling et al., 2006; Hackman & Oldham, 2010). Furthermore, work analysis instruments oppose current job demands to future job demands, the latter including and taking into account relevant strategic directions. Instruments like the JAI (Job adaptability inventory) have been developed to diagnose a job's adaptive performance requirements. Adaptive performance was in this case defined by eight dimensions: handling emergencies or crisis situations, handling work stress, solving problems creatively, dealing with uncertain and unpredictable work situations, learning work tasks, technologies, and procedures, demonstrating interpersonal adaptability (e.g. new teams), cultural adaptability as well as physically oriented adaptability (Pulakos, Arad, Donovan, & Plamondon, 2000).

On an organizational level, cultural variables in an organization like for instance stereotypical beliefs may be assessed with questionnaires but the focus of measurement is differentiated: researchers measure the effects of stereotypes on treatment of the stereotyped group (e.g. Kite et al., 2005) as well as how the stereotypes held by aging workers relate to behavior by the aging workers themselves (e.g. Maurer et al., 2008) and they target manager-employee-dyads by means of subjective and chronological age measures (e.g. Shore et al., 2003).

The outlined instruments are examples for measurements that may grasp relevant environmental characteristics of current situations, of future demands and changes. Some of the work analysis instruments also seize above all the regulation potential of work environments by assessing self-direction and employee's scope of action (e.g. Frieling et al., 2006; Frieling & Buch, 2007). The difficulty lies though in the design of instruments that are able to measure and seize all kinds of variability in the environments such as for instance seizing job relevant dimension for all kinds of jobs (managerial, physically or cognitively demanding, etc.). However, organizations should systematically analyze their regulation margins within their HR processes and practices in order to obtain valuable insights on fields of action for environmental regulation. The table below (see Table 10) summarizes the discussed variables and instruments for measuring them within a differentiated age conceptualization. The distinction between subjective and objective measurements is not

explicitly marked but the reader should keep it in mind as they may contribute to different outcomes.

***Table 10**: Example variables and possible measurement instruments*

Relevant person-related factors	**Instruments**	**Relevant context-related factors**	**Instruments**
biography	biographical interview	historical factors age of co-workers age of supervisor	age structure analysis Interviews
cognitive, physical performance, plasticity, health	performance appraisals/ supervisory ratings, subj. memory functioning (MIA, MSEQ, MFQ), pre-post-designs, transfer of learning, neuropsychological diagnostics, fitness index, WAI, absenteeism	education task complexity technological change learning environment	work analysis instruments (FAA, SALSA, JDS,…) questionnaires, statistics inventory/statistics on learning offers, learning participation
self-efficacy, subjective age, attitudes towards own age	MSE (memory self-efficacy) JOL's (judgment of learning) questionnaires	type of job characteristics of co-workers age of supervisor age discrimination culture	surveys, statistics
experience	CIT (critical incident technique), years in job, organization, interviews	organizational age norms, (attitudes toward older workers, being behind schedule), job-typing, tenure and commitment	statistics, surveys
roles / role complexity in different life phases	questionnaires self-reflection interviews on psychological contract	environments such as family, organization, social networks etc.	questionnaires, surveys

6.3 Regulation of dynamic organizational stability through HRM

6.3.1 Regulation of person-related variables

The model of quality of life management through resource orchestration assigns individuals an active role in shaping their environment. Shaping or regulating means implementing person-related regulative strategies like accommodation, secondary control, or SOC mechanisms that adapt the self to the context, i.e. mechanisms that adapt goals and priorities to a hardly modifiable context or situation (cf. section 1.2). *Insight* about own

goals, priorities, roles, activities, abilities, health and own biography and about resources and plasticity within these variables is the basis for regulative strategies. For instance, clarity about role preferences (e.g. retirement versus employment) plays an important role for older people's well-being (Warr, Butcher, Robertson, & Callinan, 2004). These insights may also be relevant in work context regarding compatibility of person and organization fit, stabilization of job satisfaction and performance. Insights could be enhanced through HR practices at different time points in a career adopting a lifespan age perspective. Similarly, these insights have to be gained with focus on the environment in order to identify personally relevant resources in it. For instance, the following questions could enhance these reflections:

- What abilities do I want to develop and train (selection)?
- What are my needs and priorities?
- What do I dare to do and why do I not dare to do something?
- What does my biography look like?
- What are my actual roles, which of them do I want and which do I not want? How are they related to my work life?
- What are my resources?
- What do I need to change? Goals, context or both?

Several authors identified *self-efficacy* as being an important factor relating to attitudes and intentions, learning behavior, or perceived cognitive capabilities (cf. Frieling et al., 2008; Maurer, 2001). HR practices may enhance self-efficacy beliefs through:

- analysis of trainees' pre-requisite knowledge and skills for complex training assignments and make preparatory resources available to all trainees.
- enhancement of older workers' opportunities to observe others similar to them successfully engaging in learning and development experiences and reduce their exposure to negative depictions of older workers' ability to successfully engage in development.
- recognition of successful learners and make older workers' success stories visible or include older ''models'' in learning materials.
- proactively and constructively address debilitating anxiety, arousal, or health factors that may reduce self-efficacy for learning and development and reduce competition in learning and development experiences.
- actively ask for experiences and know-how and actively exploit it.

Furthermore, organizations should contribute to avoid *aging of skills* by offering lifelong learning opportunities through on- and off-the-job learning possibilities as well as meta-training on learning strategies or health issues. Within this, they should consider learning biographies, use knowledge of older workers in trainings, provide self-directed study time and adapted learning material. In relation to aging of skills, employability is an important factor often discussed as it contributes rather to affective, value and goal commitment than to a commitment based on a lack of alternatives. Affective commitment in turn seems to contribute to high performance (Cohen, 1993).

All these insights about *goals, motivational structures* may then - from employer perspective - also be more easily linked and incentive systems. Findings from an international study by Incoeglu, Segers, Bartram & Vloeberghs (2009) supported propositions from literature (Zacher et al., 2009; Kanfer & Ackermann, 2004) that suggests that motivation does not decline with increasing age but shifts. They found a tendency for older employees to be more intrinsically motivated (e.g. by personal principles and autonomy) and less by features that are mainly extrinsically like competitive work environment. They also found a relationship with retirement age; countries in which retirement was higher, the motivator 'progression' (having good promotion prospects) declined less with age. These results are also very interesting from the salary system point of view; in most systems, age, experience, and salary interdependently increase. Lifelong learning and demographic development might contribute to dissolving these relationships, as biographies shift from the classic tripartition of learning/education, work and retirement to learning phases being a recurring element in developmental trajectories in which the relationship between qualitative as well as quantitative experience and reward systems also have to be rethought (Vaupel, 2010). Furthermore, there is evidence that people use different regulation mechanisms across lifespan (Heckhausen & Schulz, 1995). Taking these variations into account could help HR practitioners to adjust and differentiate their practices all along their processes. For an overview on the discussed person-related measures, see Table 11.

Table 11: *Person-related regulation measures*

Person characteristics/ Resources	*Regulative processes*	*HR Practices*
- abilities - motives - goals - attitudes, e.g. about subjective memory self-efficacy - biographical variables (e.g. learning biography, education) - roles - lifestyle - health status - … - Characteristic j	- adaptive performance - accommodation - secondary control - engagement/ activity/SOC - resource orchestration - … - Plasticity j	- foster insights - self-reflection of person characteristics - consider person characteristics and resources - provide possibilities for lifelong learning - enhance self-efficacy and positive role models - job Skill training (on- and off-the-job) - meta-training on learning strategies - health training/check - employability check - … - Intervention j

6.3.2 Regulation of context-related variables

Insight about the relevant context variables and about possible resources and regulative potential within them is the basis for the implementation of regulative strategies and processes adapting the context to the self (e.g. assimilation, primary control or SOC mechanisms). Similarly to the paragraph above, context-related variables may or may not function as resources regarding the achievement of own goals (like performance or job satisfaction). Some of the identified context-related variables (cf. section 5.3) will now be discussed in terms of their regulation on the individual, task and organizational level.

Regulation on the *organizational and individual level* may include cultural and structural regulations through educative measures in sensitization on aging topics, adaptation of incentive and reward systems, or work (time) models. Attitudes or stereotypical beliefs of coworkers and supervisors must be analyzed and regulated by means of reorganization of team compositions or organizational educative measures. The latter could include transmitting insights about lifespan psychology or building awareness on how stereotypical beliefs may impact staff selection, performance appraisals, managers' promotion of training and development opportunities and of work models like part-time or telework, or employees' thoughts about retirement (Wrenn & Maurer, 2004; Shore et al., 2003; Cleveland & McFarlane Shore, 1992; Zacher et al., 2009; Incoeglu et al., 2009; Sharit, Czaja, Hernandez, & Nair, 2009; Roth et al., 2007).

On the *task level*, either the task itself or the circumstances in which the task is executed (work conditions) can be modified. The categorization of age-impaired, age-counteracted, age-neutral, and age-enhanced activities by Warr (1993) underlines that the nature of tasks plays an important role for performance and that an optimal fit between the demands of the task and the resources and abilities of the individual executing it is crucial for high performance. Demands on task execution may change with work conditions like for instance time pressure, workload, technology, or customer needs. Ilmarinen (2005) showed that self-pacing is important for individual work rhythms in order to avoid time pressure and stress. Flexibility in work breaks, the order of working off tasks, or choice of work methods are other aspects in order to regulate work, given that the environment permits it. Self-pacing is also an important in learning situations: A meta-analysis from Callahan, Kiker, & Cross (2003) shows significant influences of environmental characteristics on older learners training performance; that is, instructional methods (lecture, modeling, active participation), self-pacing and small learning groups have significant positive effects on older learners training performance. Hackman & Oldham (cf. 2010) defined core job characteristics that contribute to experienced meaningfulness of the job, for instance the degree to which the task or job requires a variety of different activities and skills, the degree to which the job requires doing a whole and piece of work from beginning to end, and the degree to which a task or job has a substantial impact. Autonomy and job-based feedback are considered to contribute to felt responsibility for work outcomes. If the task itself does not correspond to these characteristics, other regulation measures like job rotations, job enrichments may help to compensate the lacks. The nature of jobs is though manifold. Above all in physically demanding jobs, regulation addresses workplace (re-)engineering. This entails the adjustment of work material or work conditions, as for instance avoiding monotone job contents, demands or body positions. There are examples of industrial organizations where for instance work rotations of employees decrease with increasing age, which may contribute to unfavorable development of the employees and therefore should be avoided (Frieling et al, 2008; Frieling et al., 2006; Roth et al., 2007). All in all, regulation strategies of context-related variables are numerous, but the potential is not always equally exploited. Analysis of potential for regulation margins seems therefore crucial. The following Table summarizes the mentioned regulation measures without making a claim of completeness (see Table 12).

***Table 12**: Environmental demands, regulative processes and measures*

Demands	*Regulative processes*	*HR Practices*
- work load - time pressure - attitudes of staff towards aging - work conditions - nature of task - financial status - social desirability, norms, culture - role complexity - customer demands - … - Demand j	- assimilation - primary control - regulation through SOC in context - … - Adaptation j	- mentoring systems - semi-retirement - reduced workload - self-pacing breaks, choice of methods, order of tasks - know-how transfer on generations - job enlargement - job enrichment - performance appraisal - sensitization on aging topics - analyze structures, team compositions - work analysis (JDS, …) - work (re-)engineering - T & D check - adapt reward and incentive system - … - Intervention j

Reflection and insight about relevant person- and context-related variables and the resources within them may contribute to the effectiveness of any HR process. In order to bundle HR practices along with the stability-oriented regulation model based on a differentiated age conceptualization approach, we link these examples of regulation measures to HR processes such as staff sourcing, training & development, maintenance, and separation; this may give practitioners further directions on what to tackle (see Table 13):

Table 13: *Examples of regulation within HR processes*

Staff sourcing	Training & Development	Maintenance	Separation
- Analyze organizational age structures and team compositions - Analyze quantitative and qualitative staff requirements - Avoid age indications in job advertisements - Consider team compositions (i.e. age-mixed teams vs. age-homogenous teams) - Provide or take into account context information in selection decisions of an older applicant in order to make age less salient - Engage older supervisors in selection process for older employees	- Self reflection about resources - Psychological contract discussions - Consider possible cohort effects (i.e. learning predispositions) - Consider learning biographies - Foster training/lifelong learning through on-the-job and off-the-job opportunities - Encouragement for training issues through managers - Talent management and career planning for retention management - Renew skills and avoid aging of skills - Provide knowledge about aging of skills - Make use of expertise in complex jobs - Provide knowledge about SOC-strategies	- Salary models - Policy on dealing with performance declines in physically demanding jobs - Health prevention through work condition management - Provide stimulating work environments - Provide different work time models - Culture/stereotype management of managers, HR practitioners, employees - Performance ratings and stereotypes - Mentoring programs - Adapt motivational/reward systems to lifespan - Employability management - Avoid quantitative and qualitative under- or overstrain	- Flexible retirement ages - Provide self-control of retirement point and retirement models - Assure know-how transfer

6.4 Dynamic stability

It was postulated here that regulation of both goal relevant person- and context-related variables is crucial for stability in factors like work satisfaction or performance. Above all in personality research, there is a discourse whether rather personal factors like social roles or context factors like stable demands contribute to stability. With the model of quality of life management through resource orchestration, we adopted here a rather *person-environment transactional* point of view, stating that people play an active role in shaping their environments, e.g. in proactively pursuing personally relevant goals. Fraley & Roberts (2005) argued that besides this point of view, it is important to consider as well *stochastic and*

constancy mechanisms in the discussion about stability and change in development and include all these perspectives into an integrative approach. Stochastic mechanisms are random factors like relocation to a new town, lose a loved one, or discover a new talent and are randomly distributed over time and difficult to anticipate. In this perspective, people are likely to change over time and the degree of change might depend on the degree of contextual stability. In the perspective of developmental *constancy factors*, stable demands, expectancies and influences may contribute to psychological continuity (e.g. stable demands and their role for development). If we compare s*tochastic mechanisms* to non-normative contextual influences of Baltes (1987), we did consider them in our model. And by pointing out that measurement needs to focus on change (or stability) of person- as well as of context-related variables, we may also come to the conclusion that our approach and model implies a dynamic equilibrium in which environmental factors lead to temporary perturbations in a person's developmental trajectories. As a consequence, adequate measurement of dynamic stability requires more than just test-retest data and strongly recommends longitudinal data with follow-up data for measurement of developmental trajectories.

As we have seen, measurement and regulation of relevant variables are closely linked. The key for measurement and regulation of stability (factors) like job satisfaction or productivity – ideally a common goal of employer and employee - lies in modeling the outlined (changes in) person- and context-related variables. Assuming that stability can be influenced and actively generated and that it is dynamic, stability and its regulation can be established within a certain range and through a variety of means (cf. Staudinger, 2000). The dynamic stabilization of relevant goals such as productivity, job satisfaction or person-environment fit may therefore be marked by oscillations of related variables such as person- or context-related factors and as a consequence requires some plasticity of these variables. These goals are motor and product at the same time, i.e., job satisfaction might be a result of optimal fit between person- and context-related variables but at the same it might be driving mechanism for stabilization. Job satisfaction is a very intensively researched construct in organizational psychology and is also linked to productivity or high performance. Job characteristics such as autonomy, skill variety, task identity, task significance and job-based feedback have a mediating role in job satisfaction (Oldham & Hackman, 2010). HR practices of organizations usually take these aspects into account, as seen in the regulation

section; furthermore, HR practices comprehend staff surveys that address several of the above mentioned aspects that compose job satisfaction such as satisfaction with superior, co-workers, pay, work characteristics such as variability, importance and identification with the work task, autonomy and feedback on the work result, career opportunities and so on (Korff et al. 2009; Judge et al., 2001; Oldham & Hackman, 2010). Looking at measurement of stability in terms of person-environment or person-organization (PO) fit, Hoffman & Woehr (2006) found that the measurement method used moderates the relationship between PO fit and outcome variables such as turnover, task performance and organizational commitment. That is, perceived and objective measures were more strongly related to behavioral outcomes than subjective measures. They used subjective (by asking individuals how well an individual's characteristics fit with their employing organization's characteristics), perceived (individuals describe themselves and their perceptions of organizational characteristics) and objective (ask individual and other organizational members to describe the characteristics of the organization) fit measures.

Ideally, a stable fit between person- and context-related factors may be maintained and relevant goals like job satisfaction of the employees or high productivity may be achieved. From occupational stress research we know that under- and overstrain result from a quantitative disproportion or disequilibrium between workload and available time, or a qualitative disproportion between task demands and competencies of the person (Shultz, Wang, & Olson, 2010). Opportune stability in this case is optimal use of abilities and accomplishment within complex and demanding environments contributing to high satisfaction and without the emergence of stress.

6.5 Conclusion

This chapter bases on the model of quality of life management through resource orchestration which assumes that the individual plays an active role in shaping the environment and that there are several ways to orchestrate resources within relevant person- and context-related variables in order to maintain dynamic organizational stability. For organizations, this means that an individually and organizationally relevant goal like work satisfaction or performance may be held stable when regulating the right variables with the adequate means and by taking into account the variability within the variables. This section outlined – based on the identified relevant workplace variables of (aging) individuals and

(aging) organizations – how stability as well as person- and context-related factors may be measured and how these factors may be regulated by means of HR practices.

Results of analysis lead to several conclusions: First, measurement and regulation of variables are closely intertwined – so are person- and context-related variables when it comes to their measurement or regulation. That is, measurement instruments identify the relevant factors to be regulated and as they either measure the variable itself or the conditions that favor und hinder the development of a variable as it was for example demonstrated for learning assessment (e.g. Clarke, 2004). Several measurement instruments have been outlined exemplarily and thereby the necessity of the distinction between subjective as well as objective measures became apparent, as the measurements may lead to different outcomes.

Second, measurement of variables *per se* is not sufficient in a model that regulates person- and context-related variables in order to contribute to stability factors like job satisfaction, high performance, or person-organization fit. Therefore, analysis of 'baseline-status' as well as measurement of change (or stability) and potential for change in person- and context-related factors is crucial for a dynamic stabilization of the system. Changes are manifold: age-graded, normative or non-normative and dialectically acting on person and context (Baltes, 1987); above all non-normative, random changes outside the organization such as financial crisis or ecological disasters may not be easily measurable because of their complexity and suddenness and may complicate the estimation of their impact on person- and context-related variables as well as on the stability of the system. The framework proposed by Eid et al. (2008) has been adopted to measure change. This contains measurement of change in behavior or situation, change linked to lifespan development or developmental demands and change through person- or context-related interventions. The measurement of the latter is quite prevalent in a body of research that aims at measuring transfer of learning or trainings through memory interventions or HR practices. Therein, measurement of transfer remains challenging because its dimensions are complex and manifold. Regarding measurement of changes in developmental trajectories, approaches of differential change measures in cognitive performances over lifespan on a group level as well as longitudinal studies that aim at capturing these trajectories were exemplarily outlined. The measurement of some variables does not systematically cover quantitative as well as qualitative aspects and leads to an incomplete picture. All in all, the variability in

change measurement approaches is covered but could be implemented more systematically by researchers with the aim of obtaining a more distinct measurements and evaluations of variables.

Comparable to measurement, regulation of person- as well as context-related variables often goes hand in hand and the variables are intertwined. That is, means may address the individual itself (behavior oriented) or on the other hand address relevant environmental characteristics of the person-related variable. Several regulation measures have been outlined and aligned with HR processes; similarly as in measurement, they operate and can be summarized on different levels such as the individual, task, and organizational level as well as the level outside the system. A systematical analysis of person- and context-related regulation margins is recommended for individuals and organizations in order to optimally exploit them; therefore, analysis of "baseline" status and change and potential of change of variables is also crucial for implementing regulative means. For a summary of relevant dimensions, see Figure 5.

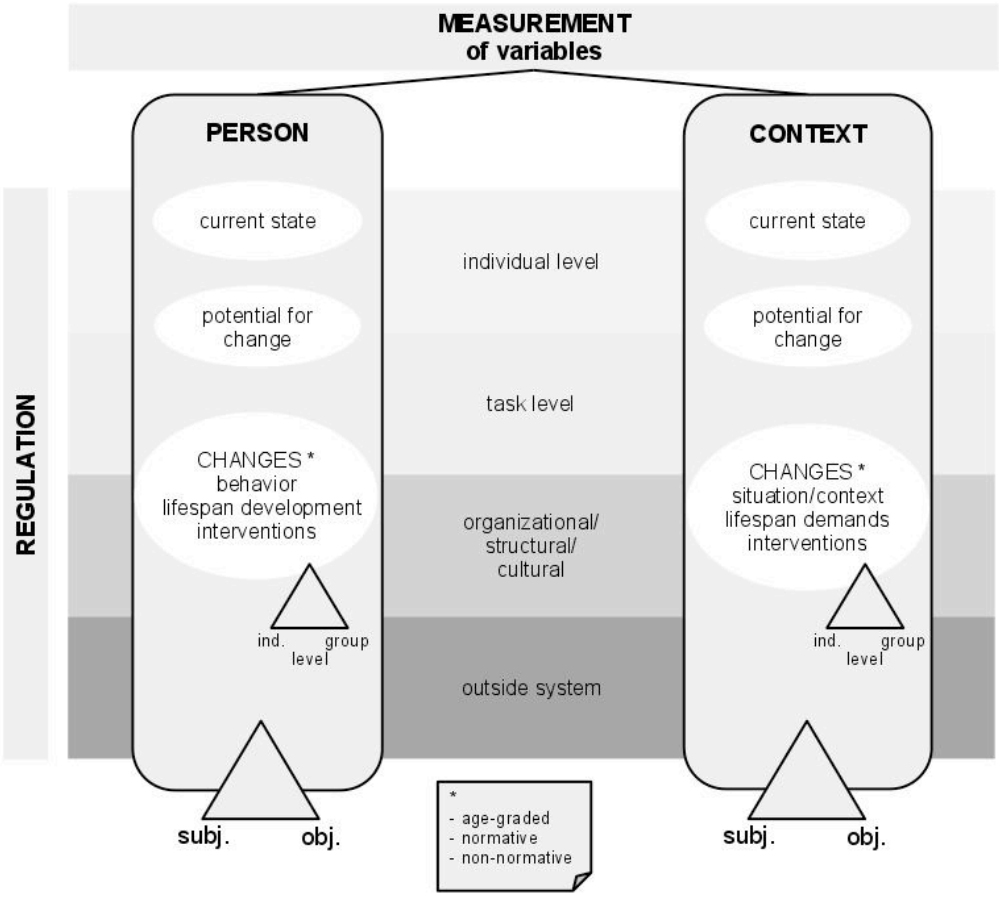

***Figure 5**: Measurement and regulation of variables*

Regarding stability, the exact quantitative interplay of variables is unclear, but we may make some assumptions on the base of the discussed literature. Disposing of a big amount of resources in person- and context-related variables is not necessarily related to higher satisfaction; but there has to be distinguished between the fit of necessary, prevailing, and used resources over lifespan (Staudinger, 2000). When demands rise, there may be a similar amount of increase in resources (given that the demand is goal-relevant) - but the increase may be relevant in different domains and abilities. When certain demands decrease, there may raise a need for decrease in used abilities. But this also depends on the temporal aspect of the decrease - that is, whether it is a long- or short-term decrease in demands: a long-term decrease in certain demands may lead to none-use of abilities, accompanied by degeneration of abilities (Hultsch et al., 1999), use of regulative processes like reorchestration and compensation of resources and goals, or change of environment.

In our model, the individual plays an active and important role in actively shaping and influencing the environment or personal goals. Organizations should invest in the diagnostic of individual and environmental or workplace resources in order to actively engage individuals in the stabilization process (Martin, 2001). Insights about regulation margins of context variables are crucial for implementing means. For instance, where work methods, order of tasks and work pace are strictly given, regulation of variables becomes difficult. Here, work analysis instruments may help to measure regulation margins. On the other hand, regulation also depends of regulation capabilities of the employees, for instance in terms of their problem solving capacities or insights in their own resources and regulation possibilities.

Similarly to the application of the intelligent resource management approach outlined by Martin (2001) and the memory management approach proposed by Zöllig et al. (2010), instruments of human resource selection, training, maintenance and separation could therefore focus on the “insights” described above based on a lifespan approach and therefore be able to

1) seize individuals’ person- and context-related resources and their changes (or stability) across lifespan (repertoire of resources, applied resources and plasticity of resources and sharpen self-insights about goals, motives);
2) seize preferred resources in terms of subjectively relevant or in the organization prevalently goals;

3) consider individual environments and action margins and their changes across lifespan (e.g. task, supervisor demands);
4) determine person-environmental fit in terms of resources, demands and goals;
5) identify and apply on the base of 1) to 4) adequate resource and context adequate preventive and interventional HR practices (by considering that not everybody needs external resources in the same domains and in the same lapses of time – this composes the necessity of domain-specific and biography-specific offers);
6) evaluate measures taken (e.g., are trained abilities even used?);

These steps may contribute to an intelligent resource-management and dynamic stabilization of high levels of productivity, job satisfaction and person-organization fit but further research is needed to evaluate such procedures and to offer a company-specific toolbox with which these variables may be seized.

7 General discussion

The following chapter summarizes the findings (chapters 3-6) and discusses their relevance and implications by relating them to the research questions presented in chapter 2. Due to the fact that results of each study were discussed in detail in the discussion sections of preceding chapters, the emphasis of this last section will be on suggestions for further research on lifespan development in work context.

7.1 Summary and discussion of results

7.1.1 Cognitive development in middle adulthood

Only relatively recently, middle adulthood became an increasingly important research focus of lifespan developmental psychology. While on the basis of stable means across middle age one could assume stability of abilities, interindividual differences in competence development, long-term effects of stressful versus supporting learning environments and the use of potentials for learning and training are at the focus of midlife research. Since cognitive abilities compose a core competence for coping with job demands, on- and off-the-job training and societal participation (Baltes & Lang, 1997), the first aim of this thesis was to give an overview of the development of key cognitive competences and factors negatively and positively influencing developmental trajectories across middle age - a population composing the heart of organizational staff.

In summary, also in middle adulthood studies demonstrate multidirectionality and multidimensionality of cognitive development. But therein, the focus on mean averages often blocks the perception of individual performance potential or performance progression. In cognitive development, memory processes like recognition, procedural memory, memory for facts and autobiographical memory remain relatively stable, while memory for names, episodic memory, source memory and prospective memory are rather exposed to changes. Learning and plasticity is possible until old age but environmental characteristics play an important role in this. Stress and depressive affect may influence cognitive performance negatively while an active lifestyle, high education levels and training experiences as well as a stimulating work environment may have positive effects on cognitive performance. Implications for future research indicate that it is crucial to integrate context variables and higher order functions such as action planning in the cognitive development research in

order to foster optimal development. Furthermore, cognitive development should be viewed in the context of personally relevant goals and goal-relevance of competences may need to be defined under the assumption of equifinality.

7.1.2 Training and plasticity

The second research question addressed the malleability of cognitive abilities through memory trainings. In most studies on plasticity using behavioural data, cognitive plasticity has been studied in the context of short-term interventions such as memory training. In order to systematically review the literature on memory training and summarize its effects, we conducted a meta-analysis of all published randomized controlled trials (RCT) between 1970 and 2007. Overall, 24 studies examining memory training effects in healthy and in mildly cognitively impaired old adults were identified and included in the analysis. Only memory trainings (e.g. memory skills training, imagery, method of loci) with cognitive outcome measures, duration of intervention with up to one year with at least a baseline and a post-intervention assessment reported, were included.

Results demonstrated significant training effects for paired associate learning and immediate and delayed recall in healthy old adults and for immediate recall in mildly cognitively impaired old adults. However, training effects were no larger than those found for active control conditions. Our results suggest that evidence on the effectiveness and specificity of training interventions is scarce. It was argued that this might be due to the heterogeneity of training protocols, outcome measures and different training approaches including a combination of several elements. The latter makes sense in terms of equifinality, because individuals may respond differently to different training elements, but with this we face some difficulties in measurement issues. More homogeneous samples or collapsing data within individuals before aggregation on a group level might provide more appropriate tests of the effectiveness of cognitive interventions.

Due to a lack of studies addressing the middle aged population, we assumed in this thesis, that malleability patterns of older ages resembles the patterns of middle-agers. This was also strengthened by one of the few studies investigating training in prospective memory which came to the conclusion that training resulted in a significant but small performance improvement on the sum score of the prospective memory tests and that these effects were similar regardless whether the participant was 45 to 80 years old (Schmidt, Berg, & Deelman, 2001). Nevertheless, research on training effects in middle age

should generally be pushed on one hand in order to obtain lifespan trajectories but on the other hand it should also be investigated in specific context like work context. Furthermore, it may make sense to foster research on the effectiveness of higher order functions or more complex behaviours such as goal-setting because it might constitute an important factor for training motivation and resource orchestration. Longitudinal data on cognitive training effects or at least some follow-up data should be integrated in order to be able to generate a more reliable measurement of developmental processes across lifespan.

7.1.3 Stability-oriented model in work context

Research questions in chapters 5 and 6 built up on the outlined person-related variable of cognitive abilities and put it into a broader context or model, as normal cognitive development and malleability of cognitive abilities constitute an important basis for successful aging in the workplace (Wrenn & Maurer, 2004; Hansson et al., 1997). That is, we wanted to investigate what other relevant variables may interplay and contribute to a dynamic organizational stability within our (e.g. demographically) changing environments. Another aim was to identify ways to measure these variables as well as to discuss regulation mechanisms within HR processes in order to contribute to stability of the model. We based our analysis on the model of quality of life management through resource orchestration and transferred it to work context, with the goal of gaining valuable insights on the identification and orchestration of relevant stability- as well as person- and context-relevant factors and their possible relationship in the context of aging workforces and organizational demography management. We tackled these questions with an integrative approach of lifespan, work and organizational psychology as well as HR practices. We draw several conclusions from our analysis, which will be outlined next in terms of a theoretical, methodological and practical point of view.

From a *theoretical point of view,* transfer of the model focusing on an individual to a model focusing on a bigger entity such as an organization is an added value on one hand but an increase in complexity on the other hand. The need for such models may rise as the world's population is aging, but the pace of this change and its consequences have not been adequately recognized (Vaupel 2010). Projections of current trends indicate that many workers will work past the traditional age of retirement. Along with this goes a redistribution of work, i.e. that the interplay between individuals and organizations may change, for instance through an increase in overlap between different life phases like education, work

and retirement, or family, work and leisure. This requires flexible lifespan models with defined relevant person- and context-related variables, which are marked by plasticity and which allow equifinality in terms of goal achievement. Goal achievement in bigger entities than individual 'systems' requires goal congruence or a certain person-environment fit. By regulating the relevant variables, goals like job satisfaction or high performance may be held stable. The framework outlined here offers a model on how to maintain a dynamic stability of an aging organization with person- and context-related variability. This variability has also to be taken into account in regulative mechanisms, HR interventions and measurement of the variables (see Figure 6, based on the model of Zöllig et al., 2010).

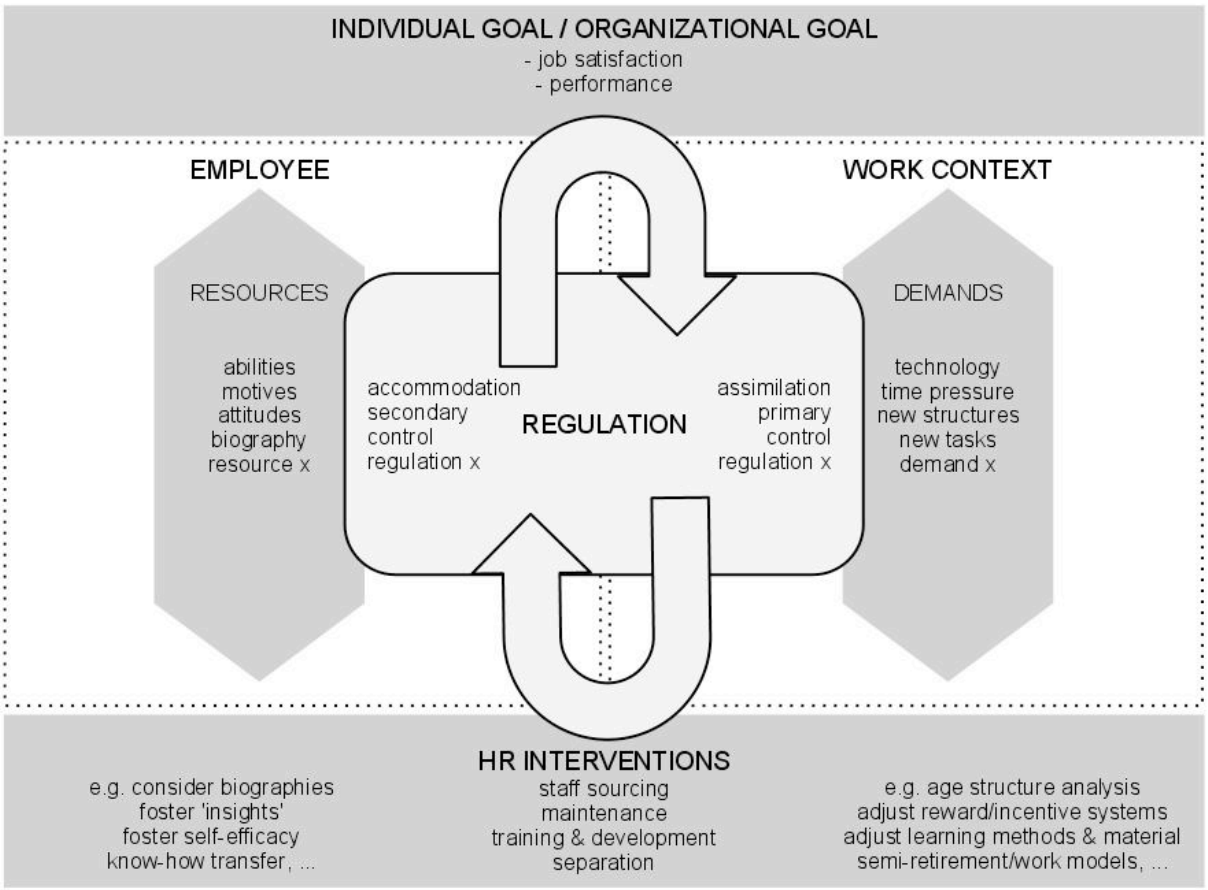

***Figure 6**: Stability-oriented Model of Organizational Demography Management*

Often, successful aging models or regulation mechanisms take effect when there is decrease or degeneration in abilities. The advantages of this model lie in its preventive character, its integration of regulative processes and margins and in its dynamic. Stability has not been discussed here as a rigid, constant state, but rather as dynamically dealing and

integrating changes in order to maintain a stable equilibrium where oscillation is possible. Person-environment fit as well as the concept of equifinality - that is, many means and the combinations of means may lead to the same requested state - play a key role for this stability.

With the research demonstrated in chapters 3 and 4, trajectories and variability in one person-related variable like cognitive development and plasticity in cognitive abilities have been outlined so far. Further research could focus on the direct continuation of the presented studies in this thesis, and theoretically and empirically investigate age differences and age-related changes in other person-related variables such as non-cognitive trajectories and plasticity of for instance emotional and social development across lifespan and elaborate consequences for the outlined model; analogically, research could also be expanded to the investigation of the variability of other context-related variables and stability factors.

From a *methodological point of view*, several measurement instruments have been outlined that seize current states of variables and their relation to others, as well as changes due to interventions, or developmental trajectories. The question of what method seizes the whole complexity of the model best remains open. The proposed model is an interdependent model without any specific dependent or independent variables. That is, stability may figure as outcome and as driver at the same time. Therefore, methods like variance analysis would not grasp the complexity of the model. On one hand, thinkable models for measurement are rather structural equation models that refer to multiequation systems in order to make statements about causality of variables. Regarding measurement of change on the other hand, Eid et al. (2008) propose latent-state-trait-models (LST) to measure variability in behavior and development; these models may even be adapted to measure intervention-based effects. Advantages of these models lie in disentangling trait changes from variability in behavior due to situations; they differentiate between different natures of changes and consider different scale types. First attempts have been made to apply these models in the field of clinical psychology, bringing them forward to this research field remains open.

We did adopt here a perspective on a bigger entity such as the individual in the organization, which already is an important step in an important direction. In organizations, individual performance is often hard to relate and not necessarily predictive for productivity.

Stable performance or productivity of an organization is due to contributions of many single individuals but it is also due to group performances. In future research, more attention should be paid on this aspect, as there are observable trends towards group work enhancement; that is, fast changing organizational structures, promotion of team-building processes, or other forms of teamwork such as for instance project teams. In organizations, we find trends from individual to collective or team performance approvals. Research in the field of dyadic performance underlines this trend and gives evidence that dyadic interaction can enhance the quality of cognitive domains such as reasoning or problem solving (Martin & Wight, 2008); but again, also in this dyadic performance research, performances vary according to the task at hand. This trend of group focus will probably gain in importance in the next decades and is related to employees' resources pool and use, as this also changes demands in terms of social adaptability and regulative strategies. In fact, this has already been recognized in terms of some measurement instruments by adding the dimension of social adaptability to work analysis instruments (Pulakos et al., 2000) but many currently proposed and applied instruments do not have a group (performance) focus yet and need to be adjusted or newly developed (Oldham & Hackman, 2010).

From a *practical point of view*, the results of these analyses offer several implications for HR practices and demography management. Organizations may maintain stable performance and job satisfaction by taking into account person- and context-related variability and fostering the optimal match between the variables and lifespan features (e.g. individual, organizational, job, product cycles). Gaining insights in relevant variables seems to be the key element for achieving dynamic stability. Furthermore, it has to be considered that aging may affect the self-regulatory processes, by which individuals implement their goals, and that differential approaches might be implemented also in HR practices (e.g. incentives and reward systems). Of course, individual treatments of countless individual cases are hardly dealable above all in big organizations; the key may lie in equifinality and attributing the individual an active role in shaping his or her environment. This means that organizations might benefit from providing a broad base of means that allows different combinations on one hand, and from fostering constant dialogue between employees and employer on the other hand in order to find the good fit. Rapidly changing environments and changes in lifespan may increase the need for intensifying this dialogue in order to remain flexible and stable.

The matter of change also has important implications for organizations: the dynamics of adult development within different contexts and the dynamics of environmental changes across lifespan have to be taken into account when analyzing the dynamics of stability in organizations. A differentiation is also necessary regarding types of jobs because complexities and demands vary, for instance in cognitively versus physically demanding jobs. Above all with the increasing number of older employees, it will be more difficult to avoid that older employees work at less physically demanding work stations; organization will have to focus on ergonomic optimization and workplace (re-)engineering and will have to foster rotations on many work stations in order to prevent performance decreases. Lifespan insights and knowledge of person- and context-related variables, changes in behavior and lifespan trajectories as well as potential for change and plasticity become therefore more and more important for an intelligent and effective resource-management.

We proposed a framework with focus on lifespan development and aging organizations. Of course, different organizations may face different challenges, e.g. there are organizations that rather face lacks of seniority that aging workforces. Our model is a general framework that offers valuable insights on organizational stability. The differentiated age conceptualization has different impacts along the HR processes of staff sourcing, maintenance, development and separation and may help organizations to tailor their practices. Furthermore, it may serve organizations as a management tool and help them identifying the relevant variables, instruments and measures. Of course, the model needs to be further developed and adapted in order to incorporate branch- and organization-specific features. As suggested in the theoretical implications, the variations in change and stability of specific relevant variables may serve to contribute to organization-specific models and toolboxes. For instance, future research could focus on models that address the question whether and what environmental or person-related changes lead to greater temporary perturbations in the organization on one hand, and would be able to make cost-benefit calculations of these consequences on the other hand. This could include all kinds of variations, such as the variation in quality or customer demands and their consequences for person- and context-related variables, or variation in work time of employees with retirement age expanding to the age of 70 years, or variation in specific context factors such as high technology work instruments. However, short- as well as long-term simulations of change and stability in variables and creation of different scenario-based

designs, and investigating how these affect corresponding relevant other variables, could contribute to the investigation of more organization-specific models and may improve this model as planning tool and toolbox for organizations. More research is need in this field in order to examine the validity and practical utility of such models.

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